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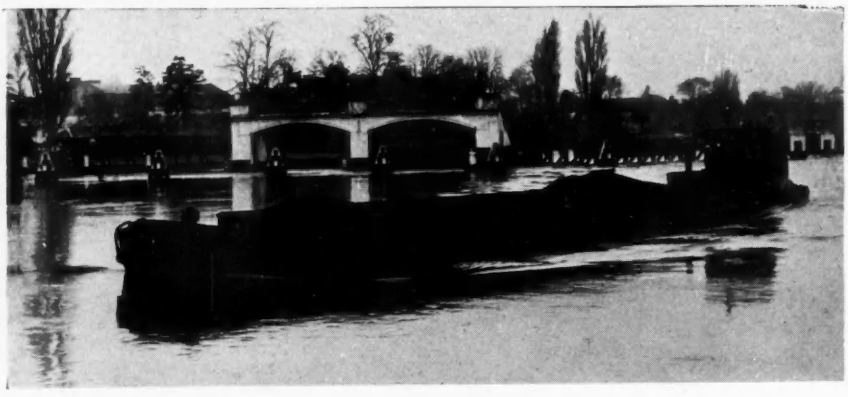

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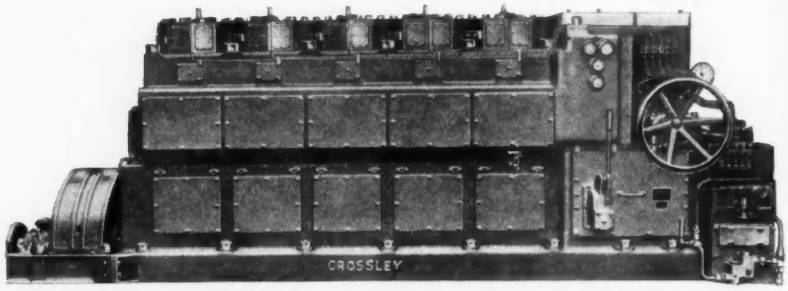

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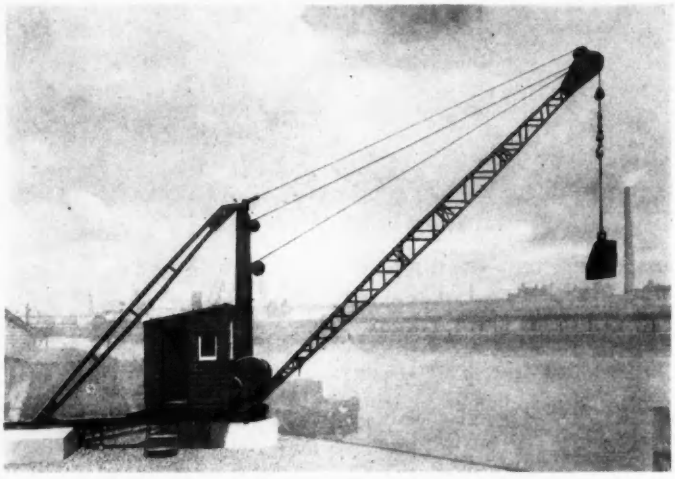

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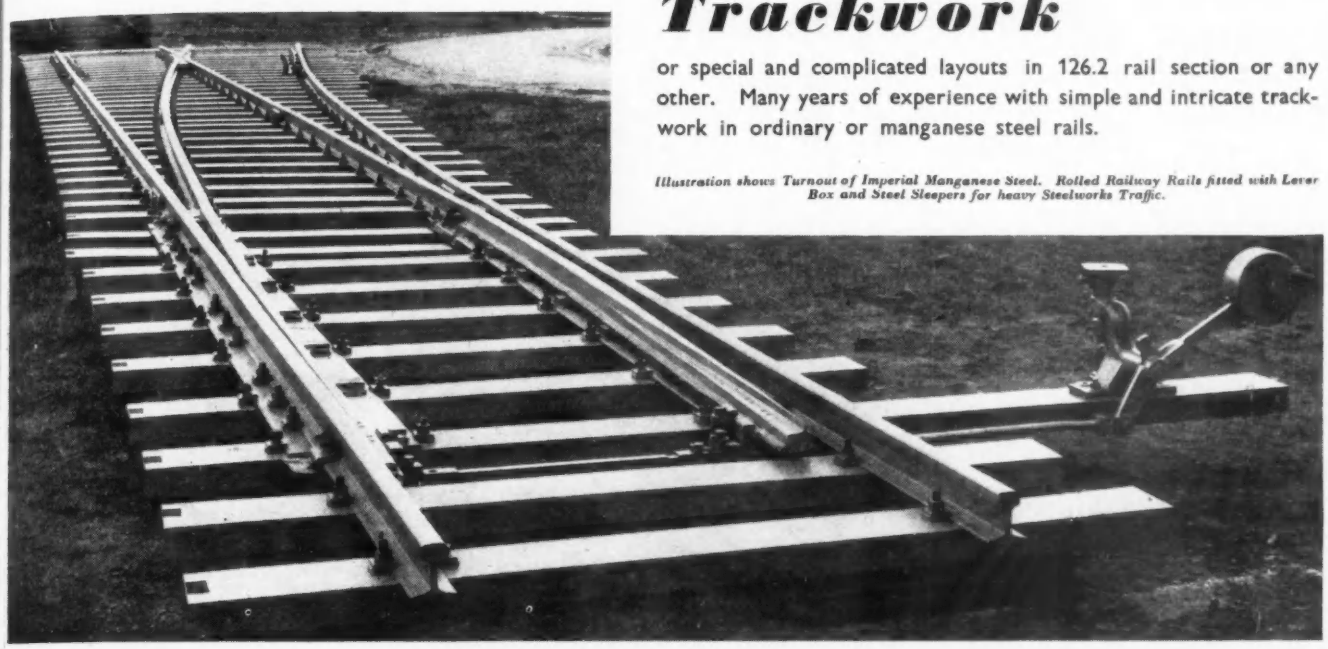

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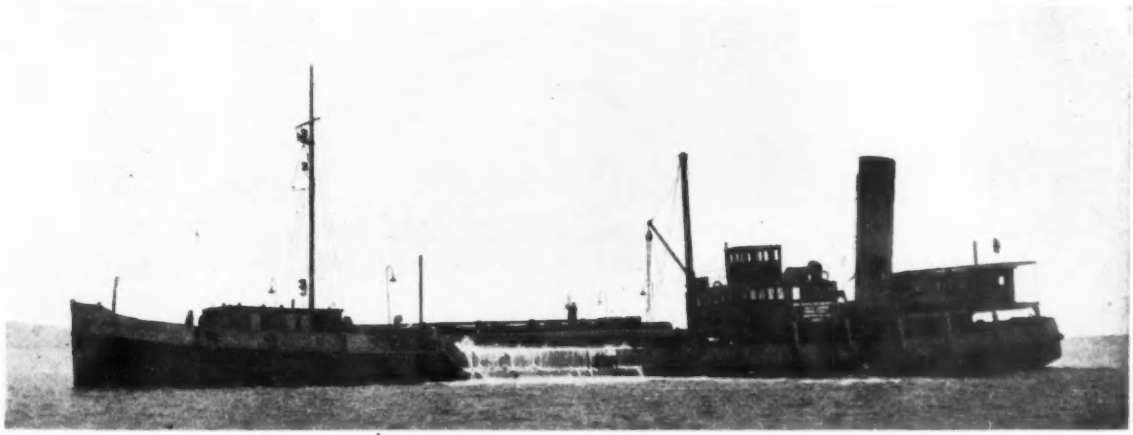

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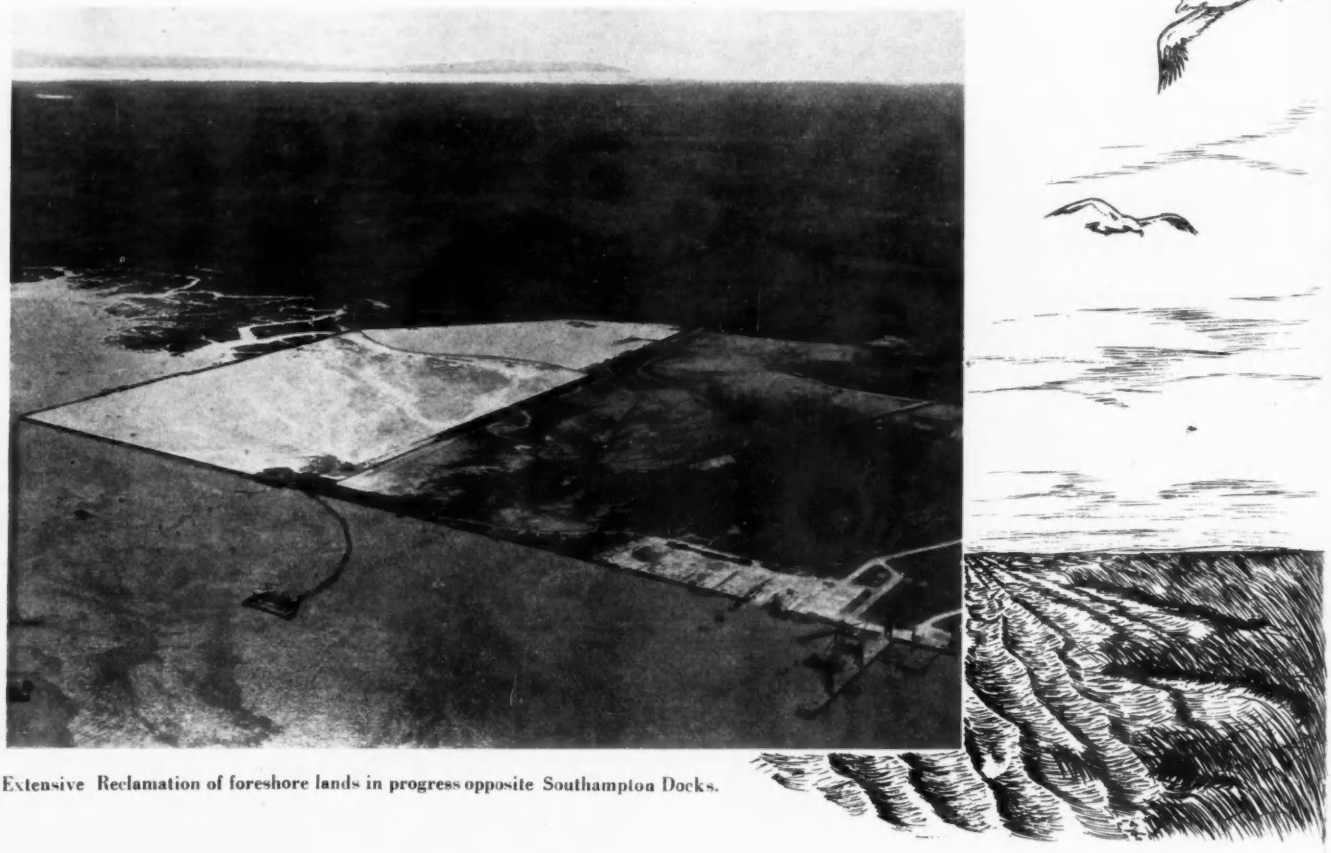

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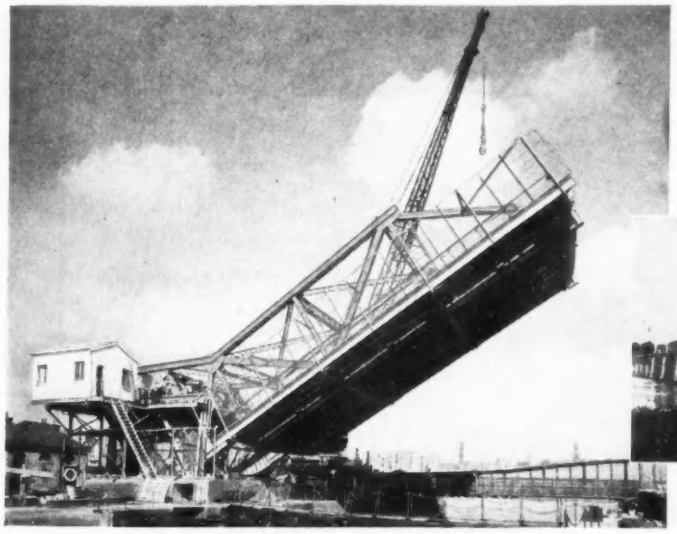

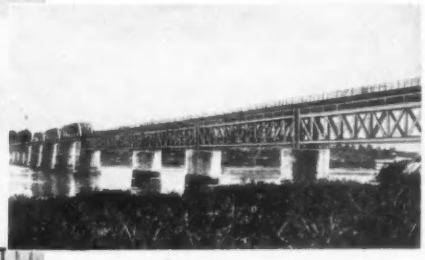

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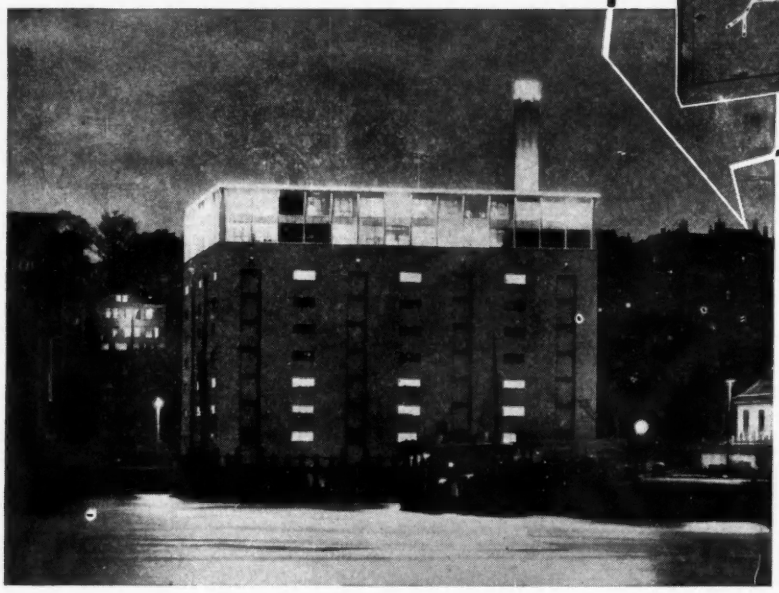

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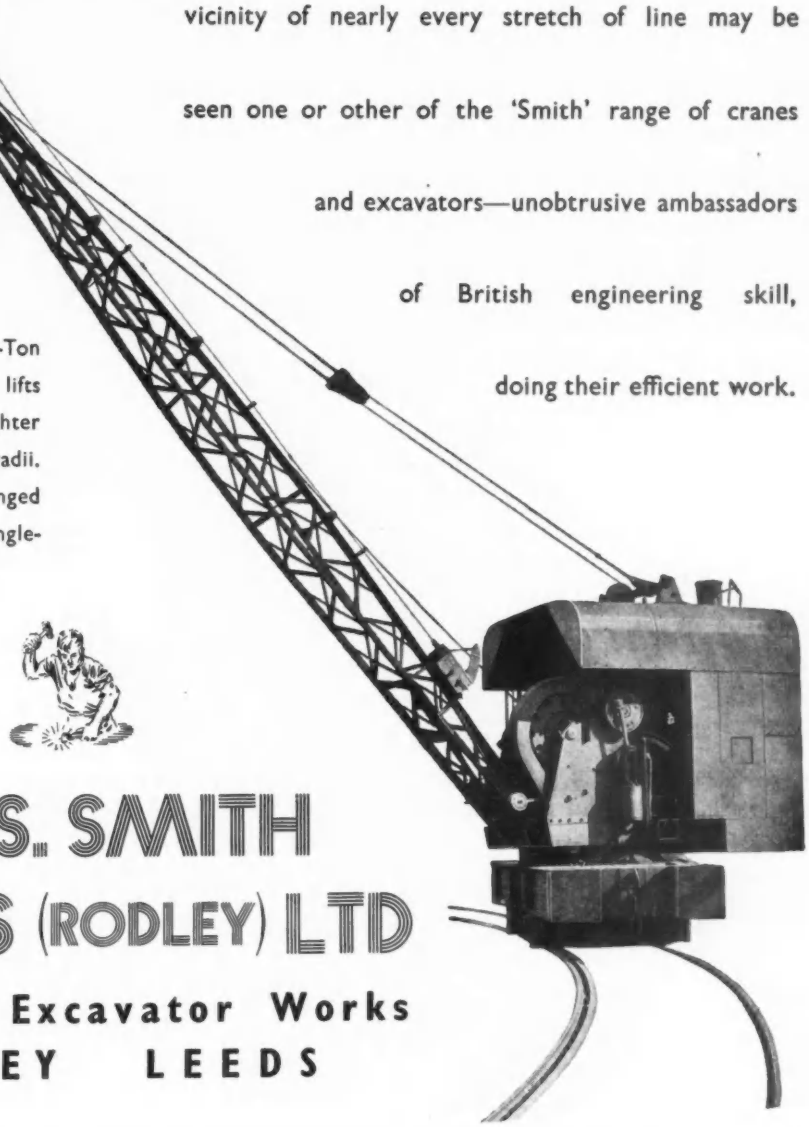

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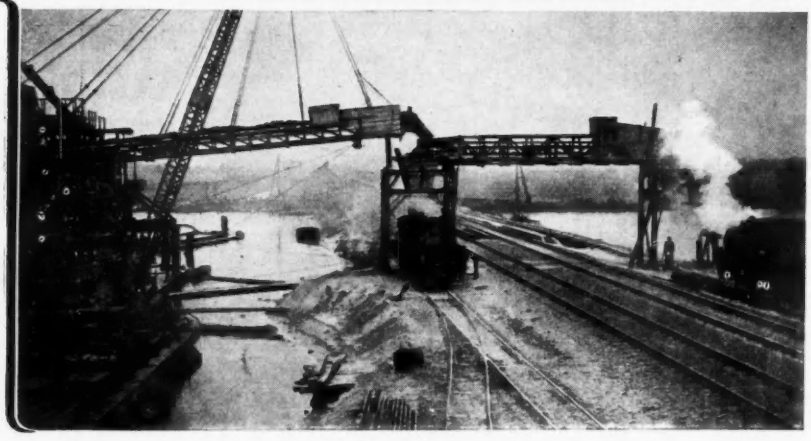

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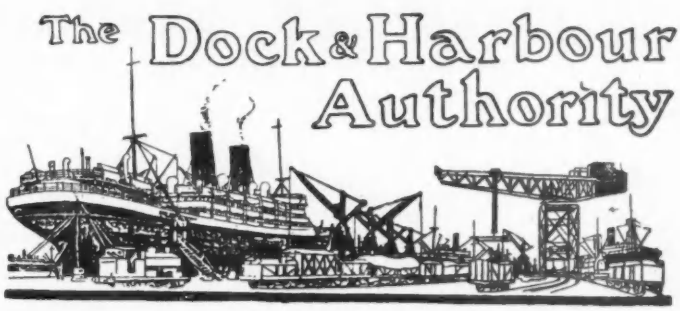

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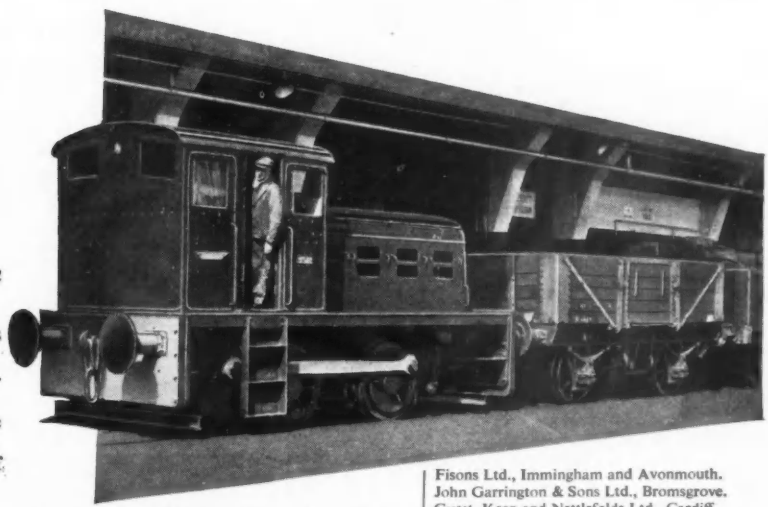

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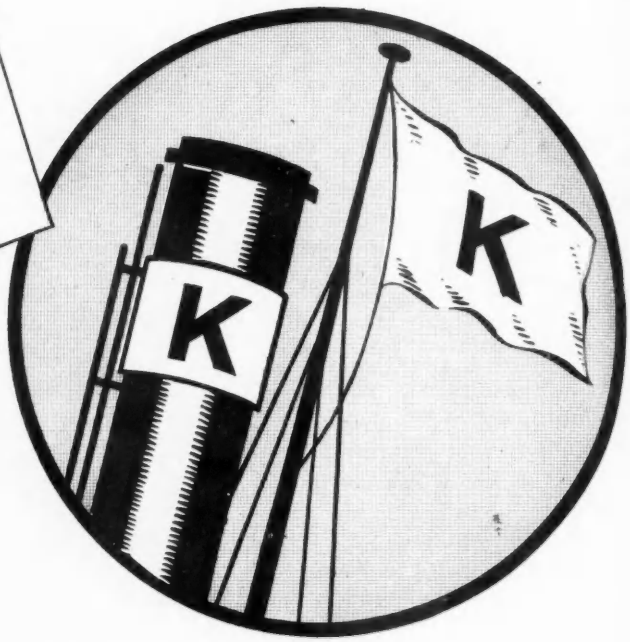

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The Dock and Harbour Authority

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Editorial Comments

European and U.S.A. Cargo Handling Methods.

We are fortunate in publishing in this issue an informative article from the pen of Dr. Ing. Hans Neumann, Chief Mechanical Engineer of the Port of Hamburg. His subject deals with the handling of cargo at ports, and he makes a thought-provoking comparison of the contrasting methods employed at ports in Europe and the United States of America. His conclusions are based on reports from an inquiry into the relative advantages of ships' gear and quay cranes, which was made in Germany recently by a special ports committee. As a result of their investigations, it was concluded that the quay crane is more efficient than ships' gear from whatever angle the matter is reviewed.

In the article, which will be found on a following page, Dr. Neumann gives convincing facts in support of this argument, and although his opinions may be regarded in some circumstances as controversial, it will be generally agreed that his views are worthy of the most careful study.

Our English readers will be particularly surprised to learn that from practical experience the author contends that "the loading and unloading of ships in European ports is performed considerably faster than in U.S.A. ports." This indeed is a surprising refutation of statements made by those who decry the antiquated and casual British methods and make favourable comparisons of the up-to-date and aggressive efficiency which prevails in America.

In fact, however, comparisons—if merely for prestige only—are invidious, as the topography of harbours, the many types of quays and piers, and the tidal ranges in different parts of the world, vary so greatly that a complete assessment of one port with another cannot be made. On the other hand, a study of the many alternative methods of cargo handling, if carried out with the object of promoting greater efficiency in the industry, which all will agree, is of world-wide economic importance, is bound to be of benefit to all concerned, and it is only by ventilating all the varied aspects of the problem, by the exchange of information and the publicising of original and novel ideas, that improved results can be achieved.

The article covers the ground so fully that, at this stage, we will leave our readers to draw their own conclusions, but we join with the author in hoping that as a result of its publication "other harbour experts will contribute to a solution of the problem under discussion."

Cargo Handling Conference.

The subject of cargo handling at ports has also been the main theme of a conference which was held in Rotterdam last month under the auspices of the International Cargo Handling Co-ordination Association. Unfortunately, we ourselves were unable to attend, but we have been informed by our special correspondent that the meeting was well attended and can be considered a success. As a feat of organising by the Association, which was only founded a few months ago, the results attained at the meeting were quite remarkable.

The six Papers read at the morning sessions served to open up the various subjects under discussion, and brought to light the problems which need to be investigated. A resumé of the Papers will be found elsewhere in this issue. From this it will be seen that the information put forward reveals nothing new, and indeed, the subject matter was on similar lines to numerous articles which have appeared in this Journal for many years past. The causes of delay to ships in port, and associated problems concerning difficulties in cargo handling, are well known and have been freely ventilated in both the technical and daily press for some considerable time. So far, however, no remedies to alleviate delays have been found. It will, therefore, be interesting to know what methods the I.C.H.C.A. proposes to adopt in its endeavours to find a solution.

With regard to the problem of the slow turn-round of shipping, many statistics have been put forward and comparisons made with the time a ship spends in port and her time at sea. There is one point, however, which does not appear to be generally appreciated. Since the war, there has been a marked increase in the length, draft and tonnage of cargo ships, but there has been little corresponding increase in docking facilities, especially where the smaller ports are concerned. Further, the modern tendency is for a ship to visit a port to discharge a full load, whereas before the war, it was quite usual for only a part cargo to be delivered. It is obvious, therefore, that under existing conditions the time spent in port to-day must be longer than pre-war. The output at the docks can only be judged by the actual tonnage handled per gang hour, and as far as we know, there has been no significant change in the rate of handling during the last decade; some ports in fact are claiming that their volume of output to-day is higher than pre-war.

Editorial Comments—continued

As far as the general terms of reference of the International Cargo Handling Co-ordination Association are concerned, it appears that the Association has not yet obtained the support of reputable bodies such as the Chamber of Shipping, The Dock and Harbour Authorities' Association and the Docks and Inland Waterways Executive. Also little assistance has, so far, been forthcoming in the United Kingdom from individual shipping companies and stevedoring concerns. On the other hand, the Association has been encouraged by the considerable support which has already been given by Continental organisations.

In our view, there is now a danger of overlapping by a number of influential bodies, all of whom are trying to find the answer to similar problems. Last month, yet another body, to be known as the Material Handling Institute, was formed, and as these various organisations apparently plan to cover very much the same ground, there is the likelihood of a multiplicity of meetings which may clash with one another. It would seem, therefore, that the most satisfactory solution will be for an overall-plan to be devised—preferably with Government backing—so that there will be a united effort, and the new bodies will avoid dissipating their energies.

Rehabilitation at the Port of Cherbourg.

Two important events in the history of the Port of Cherbourg occurred last month. On the evening of the 8th of May, for the first time since 1939, the "Queen Mary" tied up alongside the Quai de France, thus marking an important restoration of the facilities for passengers at the port. Two weeks later, M. Pinay, the Prime Minister of France, inaugurated the new buildings of the Gare Maritime which had been destroyed during the recent war.

Cherbourg was heavily damaged in 1944, the harbour facilities being wrecked by the retreating Germans, and afterwards partly repaired by American Army Engineers. The Quai de France, in particular, was almost entirely destroyed and has only recently been rebuilt and restored for the use of ocean-going liner traffic.

In the rebuilt Gare Maritime alongside the new quay, every facility for convenience and comfort has been provided. Passengers can now disembark from the largest liners in the world, and proceed directly to the customs halls while still under cover.

There are many interesting features in the reconstruction works which have been carried out, and we hope at a later date to publish an article giving a full description of the technical details and of the present facilities of the port.

Ports and the Transport Act.

The White Paper on transport policy which was issued by the Government last month gives no details about their plans concerning the ports of the United Kingdom. Also it is noteworthy that there is a complete absence of any reference to the Hotels, Road Passenger, and the Docks and Inland Waterways Executives, although it is stated that "the scheme-making powers of the Commission in respect of road passenger transport and harbours will be repealed."

From the debate in the House of Commons last week, it appears that no direct proposals have so far been made about nationalised docks and harbours, although it is likely that they will either be given independence, or else be merged into a new system of decentralised railways—the latter suggestion being considered by many as an extremely retrograde step. In his opening speech, the Minister of Transport said the Government would welcome informed comment on all aspects of the Transport Bill, and would now consult the British Transport Commission and the Executives on how to give practical effect to their intentions. The future of the Docks and Hotels Executives would also be discussed with the Commission.

We have no wish to enter into political discussions, but it is obvious that the whole Bill is exceedingly involved and controversial. We heartily endorse the statement of one of the speakers during the debate "that the greatest evil that could befall a great industry was to become the play of party politics."

From the foregoing, it seems likely that the feeling of uncertainty which has exercised a frustrating influence on port development plans ever since the Transport Act of 1947, will continue for some while to come. In order to clarify the position therefore it is essential that some definite statement of policy concerning the future of the ports should be issued at the earliest possible moment.

Suggestion for a Humber Port Authority.

An example of the prevailing uncertainty which is affecting U.K. ports was given in Hull recently when the President of the Hull Corn Trade Association expressed the view that remote control from London could not adequately cater for Hull traders' interests. He contended that serious consideration should therefore be given as to whether it would be practicable to set up a Humber Port Authority similar to other major ports, or if it was necessary for port operations to be vested in the Docks and Inland Waterways Executive, for provision to be made for the appointment of a regional board which would take an active and responsible part in those operations.

Unfair Practices in Ship Registration.

A Committee of the International Transport Workers' Federation which was set up to counteract unfair practices in connection with the registration of ships, held a meeting in London recently. The Committee noted with concern that the number of ships registered outside the countries from which they operate has reached alarming proportions. Much of the tonnage consists of obsolete vessels which are a threat to recognised standards in the sphere of safety and social conditions, and the fact that they are practically inaccessible through the ordinary legal and other channels adds to the gravity of the problem.

The Committee recalled that between 1920 and the recent war, low standard ships offered ruthless competition, with disastrous effects on freight rates, and on safety and social conditions, in both the maritime and port industries. They therefore decided to recommend the Dockers' and Seafarers' Sections of the Federation to review the present policy at a conference which is to be held in Stockholm next month.

At subsequent meetings of the Seafarers' Section, one of the questions dealt with concerned seafarers' welfare in port. Other questions included a number of recommendations on the policy of the Federation in connection with shipping registered in Panama and similar countries. The failure of many Governments to ratify the Convention providing for the establishment of the Inter-Governmental Maritime Consultative Organisation was also noted.

In seafarers' circles the need to deal with the problems of the shipping industry at inter-governmental level is considered to be greater than ever, and it is regrettable that four years after its adoption there still seems little prospect of the Convention coming into force. It is to be hoped therefore that the necessary steps will speedily be taken by the Governments concerned.

Port Equipment at Mechanical Handling Exhibition.

The Third Mechanical Handling Exhibition and Convention is being held at Olympia, London, from the 4th to 14th of this month. As far as the port and shipping industries are concerned, there will be on view many exhibits of interest, including power shovels for use in the holds of ships, various electric trucks for movement of goods in the docks, overhead travelling cranes suitable for installation in ship's engine-rooms, scale models of monotower and gantry cranes of the latest design, slings, many types of mobile cranes particularly suited to dock work, and petrol, diesel and electrically-driven winches. A model of a pneumatic floating elevating plant will also be displayed.

It is claimed that the Exhibition will be the largest of its kind in the world. Representatives from at least 28 countries have already expressed their intention to attend, and many other visitors from abroad are expected. During the Convention a number of papers will be read by leading authorities on different aspects of mechanical handling.

Tees Conservancy Centenary.

The Tees Conservancy Commission will attain its centenary as a port authority on June 11, and appropriate celebrations have been arranged for that day. After a thanksgiving service at the Parish Church of Stockton-on-Tees the guests attending the ceremonies will embark from the Stockton Corporation Quay on the paddle tug *Sir Hugh Bell* for an inspection of the river, after which luncheon will be served at the Fifth Buoy Light Station.

Handling of Cargo at European and U.S.A. Ports

Relative Advantages of Contrasting Methods Employed

By Baudirektor Dr.-Ing. HANS NEUMANN
(Chief Mechanical and Electrical Engineer, Port of Hamburg).

A Present Knowledge.

THE fact that hardly any cranes are used in North American ports for the handling of general cargo will always make a lasting impression on anyone engaged in the European port industry who visits the United States. Only for heavy lifts and for bulk cargo may ships generally count upon the assistance of cranes. This amazing aspect has often been commented upon in " The Dock and Harbour Authority" Journal and the port industry has frequently voiced the wish to know more about the reasons why in European ports general cargo is handled by cranes whereas this is performed in the United States by the use of ships' gear.

In Germany the Cargo Handling Committee of the **" Hafenbautechnische Gesellschaft "** has looked into this question and tried to throw light upon it by careful study of the pertinent literature, of reports of the experience of various other ports and by questioning shipowners, stevedoring companies and other firms engaged in the port industry and finally by our own reflections. If the writer as co-reporter of this Committee, now discloses some of the results of its work it is hoped that other harbour experts will contribute to a solution of the problem under discussion.

Already at the beginning of this century views were expressed with regard to this problem in various reports by German harbour experts who had paid visits to the United States. For the Port of Hamburg the inference drawn from their opinions was that the handling of general cargo via a quay or wharf without cranes could not be regarded as a practical proposition.

As a result of a visit by harbour experts from Bremen to the United States in 1908 a new quay shed was designed and built according to American standards. Thus the shed was not equipped with cranes; the shed had no platform on the water side and the shed floor sloped upwards at an angle of 1 in 40 towards the land side in order to obtain there a platform for the dispatch of cargo by railway waggons. When put into operation this shed soon proved to be disliked by all users and in course of time the amount of cargo handled through it dwindled to nil. The reason, no doubt, was the non-existence of cranes and the difficulty of transporting cargo across a sloping floor. After having been in operation for a short time hydraulic full portal cranes were erected on the water side. In spite of this equipment the shed continued to be disliked by operators and in later days was used as storage warehouse only. This experiment had shown that attempts to arbitrarily transplant customs of a particular port to other ports does not always produce favourable results.

The **International Association of Navigation Congresses** has repeatedly dealt with the question of handling general cargo by cranes or without cranes. The XIIth meeting of this Congress in 1912 led to the result that rules of general validity as to whether quay cranes or ships' gear should be given preference could not be established. Contrary to the opinion of the European members who voted in favour of quay facilities equipped with a sufficient number of cranes, the general reporter from the United States was of the opinion that savings resulting from the mechanisation of quay operations would not outweigh the expenses for interest, maintenance and cost of operation of this additional equipment, particularly in slack times. The prevalence of this opinion in the United States to-day, after 40 years, was confirmed by the Productivity Report on Freight Handling of the Anglo-American Council on Productivity (published in July, 1951) who encountered the same opinion on the other side of the Atlantic.

Our problem, i.e. " The relative advantages of ship equipment and port equipment for loading and discharging ships, and the mechanical equipment of ports, mechanical handling of freight " was again discussed at the XIIIth International Congress which met in London in 1923. Experts from many important ports in Europe, North and South America took part in the deliberations. As far as the arguments then put forward are still applicable to-day, they have been used in the following observations. Considering the many difficulties of the problem in which allowance must be made for many national and local practices the number of contradictory opinions was considerable. Summing up, the following conclusions were agreed upon:

(a) Shore cranes are more elastic than ships' gear. They deal more easily with all handling requirements and are better for unwieldy goods. They are indispensable for the loading and discharge of inland water craft.

(b) According to the opinion of some reviewers, ships' gear is considerably slower than the shore crane, others think it to be equal to the shore crane in handling capacity. The fundamental disadvantage of ships' gear is that it is not able to reach far enough and high enough on to the quay—particularly in ports with large rise and fall of tide—and furthermore cannot deposit cargo at every desired spot.

(c) The largest handling capacities are obtained by joint employment of ships' gear and crane, the ships' gear working on the off-shore of the ship on to and from barges or transferring cargo out of the hold on to the deck.

(d) The timber piling of American piers in those days was not able to support the loads developed by shore cranes.

(e) Since the better economic efficiency of shore cranes was not, then accepted by the American reviewer, and conditions prevailing in different ports differ too much, no general rules for the employment of shore cranes of ships' gear can be laid down.

(f) However, shore cranes are preferable for ships moving between fixed terminal ports. In all cases where ships may not count upon fixed ports of call, ships' gear ought to be better developed.

The deliberations of the various conferences were supplemented by exchange of practical experiences, Europe and also America sending committees to the other continent for the purpose of studies. During recent years these mutual visits have again been resumed. On both sides of the Atlantic they have given rise to renewed examination of the question whether handling of general cargo is to be performed with cranes or without cranes.

Even to-day, from conservative practice, the handling of general cargo in American ports between ship and shore and vice-versa is done exclusively by ships' gear, whereas European ports since about the middle of last century have equipped their quays or wharves with a dense equipment of steam, hydraulic and, later on, electric cranes. Solely for the handling of heavy lifts shore cranes with a capacity of 10 to about 30 tons are available in isolated cases in the United States, unless floating derricks are employed for this job. According to the above-mentioned Productivity Report on Freight Handling, the Port of Boston, is however now considering equipping two new quays with cargo cranes intead of relying entirely on ships' gear as hitherto. The further development in North American ports (amongst which New York, for instance, is faced with the need of a vast scheme of modernizing its port facilities) will be followed with great attention by European port experts.

In the meantime, however, a decisive change has taken place in the United States, with regard to the movement of goods from the point of deposit upon the quay apron into the sheds or from the

Handling of Cargo at European and U.S.A. Ports—continued

shed to the hook of the ship's tackle. Whereas in former times the transportation of goods was performed by the use of hand-barrows the rapid development of mechanisation has meanwhile also taken hold of the ports. The vehicles—motor trucks, fork lift trucks, mobile cranes, etc.—are generally driven by petrol or diesel engines; however, it appears as if the electric vehicle is also gaining ground in the United States. All vehicles are speedy and handy and allow the American port engineer to build wider quays and wider sheds, since the vehicles can easily and economically master larger distances. These handy appliances have developed into a valuable supplement of the ships' gear as they can, by elastic employment, adapt themselves to the capacity of the ship and cause no congestion to the flow of traffic.

B **The difference between the sea ports in Europe and U.S.A.**

(1) **Natural differences.**

The rise and fall of the tide on the Atlantic and Gulf coasts, where the oldest and, for a long time, most efficient ports of the U.S.A. are situated, is less than one metre, and therefore considerably smaller than in Europe, where in some ports it rises up to 8 or 10 metres. Thereby the use of the ships' gear is made considerably easier in the U.S.A. since, in ports with a large rise and fall of tide, the ships' gear, though not impracticable, is at a considerable disadvantage compared with the shore crane. In the case of smaller ships it is sometimes impossible to handle goods ashore by ships' gear.

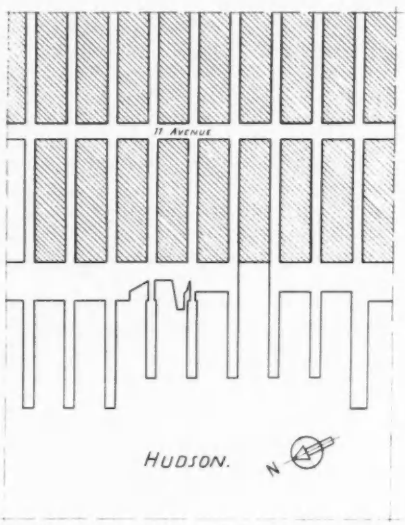


Fig. 1. Layout of piers in Manhattan (New York) in continuation of streets.

The Port of New York has had, and still has, a strong influence upon the development of American cargo handling technique. A look at the map of New York's port shows that the piers (specially those on the Hudson) form the continuation of the "streets" of Manhattan. This appeared to be most appropriate to the interest of a smooth run of traffic when building them (Fig. 1). Over large stretches of Manhattan the street blocks have a width of 70-80 m. only. Since with due consideration to easy manœuvring of ships the water area between the piers could not be too narrow, the piers proper were allowed a very limited width only. They do not therefore offer space for pier cranes, and as a result, the handling has to rely exclusively on the ships' gear. Many of the piers have been built as timber pile structures and are not calculated to support the heavy concentrated loads which would be developed by cranes. Pier sheds as a rule are similarly of light structure and not suitable to carry a crane on their roofs. It may be accepted that New York has been the model for many other ports in the U.S.A. in regard to the substitution for cranes of other methods of cargo handling.

It may furthermore be assumed that **tradition** has played a considerable part regarding the lack of cranes in American ports in so far as before the first world war the U.S.A. did not own a merchant fleet of any considerable extent, and for this reason showed little interest in saving the gear of foreign vessels by the employment of port-owned cranes.

After the first world war the **American economy** gained increasing importance for all other countries, a development which has continued into our times. Therefore the North American ports can afford to leave the handling to ships' gear and neglect competition, whereas European ports, by reason of competition, must offer assistance by cranes. This is good proof of the overwhelming economic strength of the U.S.A.

(2) **Organisation.**

In contrast with Europe, where the ports were developed from the beginning by the assistance or initiative of the State, the majority of the sea ports in the U.S.A. have been developed by the **transcontinental railway lines.** Considering the large number of railway companies, it frequently happened that several railroad companies erected their handling facilities on sites advantageous for the development of ports. For example, within the port district of Greater Hampton Roads on the Atlantic Coast, altogether 9 railroad companies operate their own port facilities. Whereas, to-day, the terminals of these lines generally are connected by so-called "belt-lines," railroad waggons being shunted via these to the ships' berths, in former days, it used to be standard practice to move the ship in order to load and discharge at the terminals of land transport. This of course meant that at different berths a ship often handled small lots only. By the use of shore cranes under such circumstances hardly any saving of time would have been gained considering the lengthy times wasted by moving the vessel. Shore cranes would have been most uneconomical for the owners of berths since the duration of their employment would have been very limited. The competition of the numerous interests in one port has furthermore resulted, as still may be noticed to-day—in the handling facilities and the shed space being used to a considerably smaller extent than is the case in European ports. Reports published lately about the Port of New York show that the berths at piers leased to individual shipping companies are used less than 50 per cent. For this reason the facilities have been built with considerably less expense and it can well be understood why the money for expensive crane equipment has been saved and use made preferably of ships' gear which is available in any case.

This latter point of view still carries great weight even to-day when **municipal and state initiative** have come more to the fore and the organisation therefore of the ports begins to adapt itself to the European ideas. This may be the reason why equipment with shore cranes is not considered necessary even in the case of new facilities, although this question has been investigated in great detail, particularly in such cases as when completely new ports were created during the last few years (e.g. Newark).

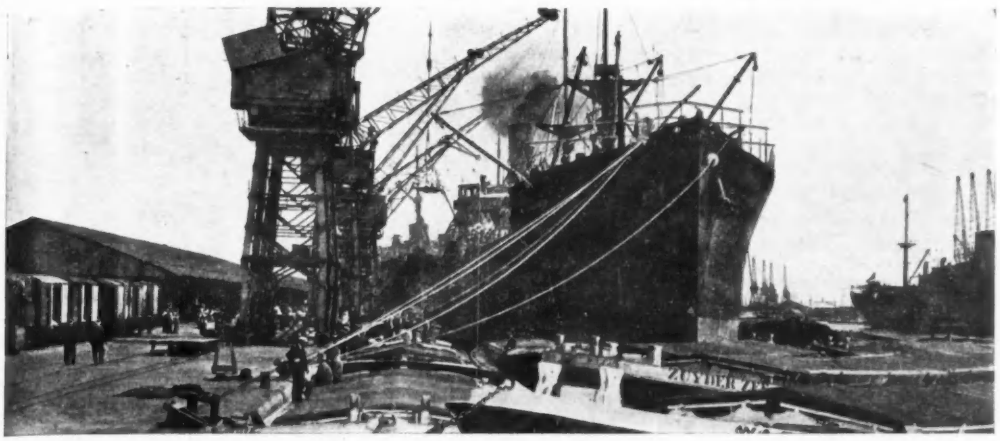
(3) **Means of transport.**

In American ports transportation of inbound and outbound cargoes is taken care of, in the majority of cases, by the railroads, and to a smaller extent by truck (lorry), whereas inland water transport is of no importance in most ports.

There is no need therefore to take **inland water transport** into special account when the question of equipping facilities in seaports is under consideration. The reason for this development may be found in the merciless fight waged by the railroad companies in U.S.A., at the time of their stormy development, against inland water transport as their competitors which led to the crippling of the latter by open and secret undercutting of tariffs. For decades many rivers and canals which formerly had carried a lively traffic found this struggle to eliminate competition by inland waterways and to dominate any indispensable water transport was the more or less successful attempt by the railroad companies to obtain early possession of the water front in order to prevent the establishment of public facilities for the handling of goods. Due to such development the American businessman, for the transport of general cargo, still to-day prefers the faster transportation by railroad and truck as compared with inland water craft.

In most European ports, however, inland water transport is of considerable importance. According to a number of reports from different ports, 75 per cent. of cargo handled at the modern docks in London is transported to and from the wharves by lighter and barge. At Rotterdam about 70 per cent. of all cargo handled is

Handling of Cargo at European and U.S.A. Ports—continued



Electric quay cranes and ship's derricks unloading vessel "overside" into barges and to quay, at the Port of London.

Photo Courtesy of the Port of London Authority

carried by inland water craft; at Amsterdam this figure is even higher, viz. 90 per cent. In pre-war times more than 50 per cent. of all cargo handled at Hamburg was transported via inland water ways. These examples could easily be augmented. It is therefore often the practice in European ports, during the loading and unloading of a seagoing vessel by shore cranes, to use the ships' gear on the off-shore side of the vessel for the servicing of inland water craft alongside. Apart from the long-distance transport via inland waterways, the heavy transit traffic and the physical separation of transit sheds and warehouses (e.g. at London and Hamburg) in Europe leads to an increase of inland water transport within the ports. Ocean-going ships loading cargo in transit, as well as the warehouses, receive their goods out of barges which have been loaded at the quay or wharf by shore crane with merchandise sorted at special transit sheds. In this respect port operators are of uniform opinion that particularly this type of handling between shed and harbour craft in many cases requires more cranes than the transfer of cargo between shed and steamer.

As against the **truck (lorry)** the railroads in the United States have been able to preserve their traffic volume to a large extent due to the generally much longer transportation distances. Here the railroad is still faster and more economical, and is in possession of a great advantage by the ownership of its own facilities in the ports. Older reports emphasise that, in former times, mostly covered waggons were used in the United States in order to protect goods better during their transit over usually very long distances. In contrast with this, open waggons without a roof are used in Europe very often, tarpaulins being applied in such cases to protect the goods against the weather. Covered waggons cannot be loaded direct by crane. The method of transport in U.S.A. as described above, may possibly no longer prevail, but it is worth mentioning since, when considering all aspects of the question, it must be borne in mind that traditional practice plays a part which can not be disregarded. Since in the U.S.A. the piers for handling cargo are predominantly the private property of the railroad or shipping companies, they are operated under conditions altogether different from those at the service of public interests only. Means of transport to the steamer or from the ship here and on the other side of the Atlantic are different. This has no doubt had an influence on the development of the piers.

It is furthermore significant that in many American ports trucks (lorries) have to pay a special fee for the use of facilities belonging to railroad companies. Figures which have been published with regard to the employment of different means of transport in the ports of the United States show that about 75-80 per cent. of the whole transport is performed by the railroad and 20-25 per cent. by road vehicles. In special cases (e.g. Norfolk) 95 per cent. of all transport is taken care of by the railroad and 5 per cent. only by truck (lorry).

In many ports of Europe the ratio between railroad and road transport has changed so considerably after the second world war that, in part, it may be called a complete reversal of conditions. In German ports the share of road transport is particularly high since the last war. In Bremen to-day about 60 per cent. of cargoes requiring means of land transport are conveyed by waggon and about 40 per cent. by truck. However, a considerable differentiation between in-coming and out-going cargo has been noticeable. In Hamburg during 1950 goods for export which were handled over the quay were transported by rail and truck in a ratio of 58 per cent. to 38 per cent. whereas 28 per cent. of import goods handled via the quay were hauled by rail and 56 per cent. by truck to their destination inland. In England the influence of road transport is still more pronounced in some cases. Statistics of the Port of Liverpool divulge that in 1949 about 43 per cent. of all general cargo imported was hauled by road transport, about 15 per cent. by rail and 23 per cent. by inland water transport or coastal shipping. Approximately 9 per cent. of all goods discharged at the port were stored on the site in warehouses or silos. Goods for exports were conveyed to the port by road, rail and inland water transport or coaster at the ratio of approximately 71 per cent., 18 per cent. and 11 per cent. respectively.

(4) **Nature of cargo.**

In many ports of the United States export cargo predominates particularly so if a port has specialised in the export of a particular product of the country. In contrast, imports predominate in most European ports. Export goods in the United States are frequently of one kind in large quantities and of uniform packing so that in many cases it is admissible to talk about shipment of general cargo in bulk. In these cases ports or port facilities have been specially equipped to meet this kind of shipment. Large shipments of uniform import cargo have, so far anyway, been predominate too.

In **European ports,** however, for imports as well as exports, the handling of general cargo in the most varying types of packing and in small lots must in the first place be taken into account (Fig. 2). Furthermore import cargo in many cases will have to be sorted according to markings, partially weighed and stacked

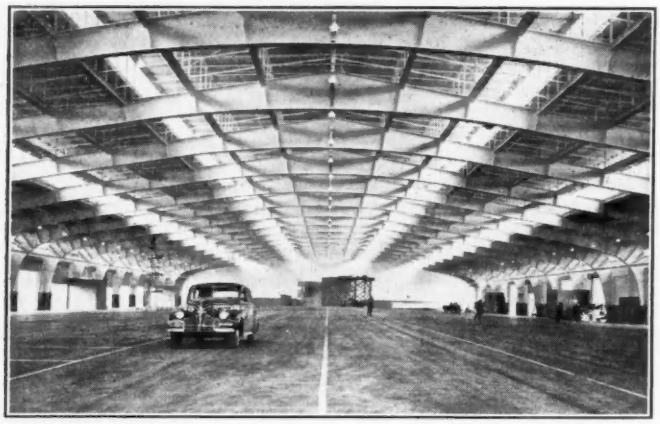
Fig 2. Miscellaneous general cargo in German quay shed.

Handling of Cargo at European and U.S.A. Ports—continued

conveniently for the taking of samples. The transit shed in European ports, and particularly so in Germany, therefore plays the role of a roofed-in sorting table. In such cases the stacking of import cargo for easy sorting and manipulation is possible only to a limited extent; this all the more so as the parcels in many many cases are consigned to a large number of different consigners who remove their goods from the transit shed within a short, but, uncertain lapse of time, and who wish to dispose of the merchandise without any large waste of time and labour. For the handling of this type of varying general cargo a very versatile handling gear of general utility like the quay crane is alone acceptable.

(5) **Safety regulations.**

Precautionary rules and regulations for the **prevention of accidents** laid down by the competent local authorities are less stringent in the United States than in most European countries. They do no impose on cargo handling operations any so strict precautionary measures with regard to the human element and to testing of materials. This is especially so with regard to the loads which may be handled per sling in case of certain goods. In this respect the opinion may be held that in some European countries the requirements which have been imposed exceed reasonable limits. However, they must be taken into account as matters of fact.



Interior view of transit shed at the Port of Long Beach, California, U.S.A., showing the clear span and height available.

The regulations for the **prevention of fire,** too, are considerably more rigid in Germany than in other European and North American ports. For example even to-day vehicles equipped with petrol or diesel motors are prohibited inside a shed or warehouse.

In U.S.A. ports trucks with their petrol or diesel engines enter one-storey sheds as well as the upper stories if these have been arranged for truck access. Furthermore, and much more frequently gasoline or diesel driven cargo handling equipment (motor trucks, fork lift trucks, mobile cranes etc.) are employed anywhere inside a shed, even amongst easily inflammable cargoes (cotton and the like). Fire insurance companies approve of this provided effective overhead sprinkler installations are available. Officially the use of gasoline or diesel engines inside pier sheds does not appear to be prohibited anywhere.

(6) **Technical arrangements.**

In the following paragraphs the differences will first be shown between the layout and the equipment of port facilities in European and in U.S.A. ports in so far as they have a bearing upon the problem of freight handling, in order to draw pertinent conclusions.

With regard to **Shed constructions** in the U.S.A. the older sheds are mostly double-storied, the newer ones of one-storey only. Width of shed, hardly more than 30 m. in older facilities, has grown up to 60 m. in new ones. On the European continent the majority of sheds are of one storey, in British ports very often of two stories. In Europe the width of sheds has been increased earlier than in the United States. Quay sheds in Hamburg some decades ago, had reached a width of 50 m. whereas at present some sheds in Bremen are even 65 m. in width.

On principle there are no **shed platforms** on the waterside in U.S.A., however they have been arranged almost in all cases on the landside for the servicing of waggons. Difference in level has been overcome either by gradual sloping of the shed floor from the water towards the landside up to the required height of platform or by depressing of tracks. In Germany the shed floor has been built raised in order to have platforms on all sides of the shed. In other European ports arrangements are similar. However in the Western European ports generally, no platforms are available, and those still in existence are to be removed. In British ports sheds have partly been built completely without platforms, sometimes they have a platform on the off-shore side only.

On principle **rail access** is available in the U.S.A. on the land or on the off-shore side of the shed only, in the case of pier sheds, also within the shed by the arrangement of depressed tracks along the centre line. With regard to rail service, New York is an exception since in this port no tracks can be provided on the piers due to lack of space. Waggons are ferried by car-floats from the rail terminals to the ship and handled alongside. Quay facilities of late construction in U.S.A. in some cases, have now been provided with 2 or 3 tracks on the water side for the direct handling of cargo into the ship as this kind of traffic evidently becomes more and more important.

In Europe rail access was originally provided on both water and off-shore side of sheds. According to the volume of direct handling between ship and waggon rail service on the water side is preferred. The latest sheds in Hamburg have been provided with three tracks on the waterside, in Bremen up to four tracks. Due to the increase of road transport, particularly in German ports, this has led to the abandonment of rail service on the off-shore side of sheds in order to obtain sufficient length of platform for the loading and discharging of trucks. In order to take care of peak rail transport in some instances one truck has been built, paved-in, on the off-shore side. In British and Western European ports rail access on the off-shore side is still quite the custom in many cases. The truck (lorry) is serviced in the United States on the quay, in the shed and to a limited extent on the platforms at the small end of the sheds. In many European, and amongst these in German ports, road vehicles are not permitted inside the sheds. In the Western ports the truck is not completely excluded from the inside of sheds. At quay sheds of late construction in Hamburg trucks may use the water-side platform in order to facilitate the direct handling of goods into the sea ship.

(7) **Human efficiency.**

The opinion sometimes expressed that the working capacity per gang in relation to human efficiency is larger in connection with ships' gear than with the shore crane does not hold water. However, reports by visitors to ports in the U.S.A. show that manual work in U.S.A. is performed to a considerable extent by coloured labour whose physical strength is being largely exploited in this connection. In one of the U.S.A. ports a particularly high efficiency is obtained per man and shift by the exclusive payment of a premium to the gang boss. Such a procedure is impossible having regard to conditions in Europe, but by payment of efficiency premiums which benefit every man of the gang a remarkable increase of efficiency has also been obtained in Europe.

In the port of Rotterdam lack of skilled labour has led to a highly general use of freight handling appliances for the transport of goods in either direction, regardless of economic results of this method.

Other sociological reasons for the neglect of cranes for general cargo in U.S.A. have so far received little attention from all reporters in former investigations since their influence is not readily observable. However, some reports by American harbour experts show for example that the influence of the trade unions, who very largely regulate labour conditions in U.S.A., has played an important part with regard to increasingly equipping harbour facilities with mechanical appliances. However, only an American very well conversant with conditions in the various U.S.A. ports would be in a position to throw light upon this influence and other sociological reasons, for a foreigner would hardly be able to trace these complicated relations right down to their source. It may be sufficient in this connection to have pointed out the dif-

Handling of Cargo at European and U.S.A. Ports—continued

ferences in working conditions as they appear to be influenced on either side of the Atlantic.

C **Handling of cargo with and without cranes.**

(1) **Influence upon the layout of quay cross section.**

Should a European port decide to adopt the North American practice it would not just be sufficient to remove existing cranes. In such an event the whole layout of the port would have to be altered, thereby giving it altogether a different aspect. In European ports it is possible to develop the **width of a quay** to suit the requirements of transport, nature of cargo, and of storage (for goods not subject to influences by weather). The American system only allows a width of quay from quay face to shed wall of about 7 metres in case loading and discharge of a vessel is to be performed by ships' gear exclusively without other means of assistance. In this case an arrangement of three or more tracks on the quay must be abandoned. If this is not feasible sheds would have to be provided with steel girder structures overlapping the roof for the appliance of pulley blocks for use in connection with the American burtoning system.

If ships' gear is used exclusively for loading and discharge any **shed platform** is highly obstructive. Transport into the shed of cargo deposited on the quay apron cannot overcome this difference of level. For this reason the platform on the waterside would have to be omitted on all quay facilities which are serviced exclusively or predominantly by ships' gear.

If cargo is handled by crane the platform does not obstruct operations, with one exception, however, i.e. if in case of full portal cranes straddling two tracks (Rotterdam) the off-shore leg of the portal rests between track and platform.

The layout of a quay cross section cannot, furthermore, be dealt with exclusively with regard to problems arising from the loading and discharge of the seagoing ship. The usefulness of a length of quay and its economic efficiency depends to a large extent on the dispatch of the various means of Transport (railway, truck and inland water craft), which convey cargo to and from the shed.

It is of equal importance therefore to arrange the layout so as to facilitate a smooth dispatch of goods traffic in addition to the most convenient handling of the sea ship. When planning the layout this should be kept in mind.

If the American practice were adopted in European ports shed floors would generally have either to slope up to the off-shore platform or provision be made for depressed tracks in the road. As this is not desirable in ports of limited area, on account of the necessary gradients for access, and as a sloping shed floor is also obstructing to shed transport, all platforms at sheds would have to be abolished.

The quay apron would have to be concreted for traffic or trucks and cargo handling gear, or covered by concrete slabs. Paving by stone is not suitable as any movement of handling gear with wheels of small radius would thereby be obstructed and the gear itself, particularly so in case of electrically equipped appliances, would soon suffer by continuous shaking.

(2) **Influence upon the dispatch, of means of transport.**

It is an essential advantage of handling cargo by cranes that the movement between ship and shed, i.e. **across the quay,** is carried out on a different plane to that on which the longitudinal run of traffic on the quay takes place (Fig. 3). By the employment of cranes the possibility is given to arrange for unobstructed longitudinal traffic for other means of transport on the quay proper. Since by this practice the longitudinal fronts of the sheds on water and off-shore side are equally available, for normal transport rail and trunk service may be separated from each other without having to enter the shed. Thus the dispatch of traffic as a whole is made easier. Rail movement is of course tied to the rail and dependent in certain hours of marshalling during breaks in shed operations. Rail and truck movement are not very compatible with each other on the same length of quay, since arrivals of trucks cannot be foreseen with certainty and truck drivers insist on preferential dispatch. This knowledge has not been gained in Europe only, for also in American ports trucks and railway work separately from each other. However, in the U.S.A., the railway in accordance with its larger transport volume is given preferential service by the availability of the off-shore shed platform whereas the truck is serviced either within the shed, and takes up storage space there, or will have to put up on the quay with the transversal traffic of handling gear of all kinds.

The **servicing of inland water craft** is a special problem in cases where ships' gear is used exclusively. As long as inland water craft, lighters or barges, for port service tie up directly alongside the sea-going vessel no difficulties arise. However, as soon as lighters or other craft tie up, several rows deep alongside, or in case cargoes for dispatch later by water have meanwhile been deposited ashore, additional equipment for handling will have to be available. This applies also where ships are loaded or discharged when moored at dolphins or buoys in mid-stream and their cargo is transported by harbour barge between quay and ship and will then have to be handled from or onto the quay by crane assistance.

In Hamburg, for instance, where transport by water from and to the quay is quite voluminous the use of cranes under normal conditions for the discharge and loading out of and into harbour and inland water craft is heavier than for the handling proper of goods to and from ships. According to investigations made in 1930, the number of shore cranes used for this purpose in the Port of Hamburg was 1½ times that of cranes required for the servicing of ships, while at some of the largest sheds was even twice as much.

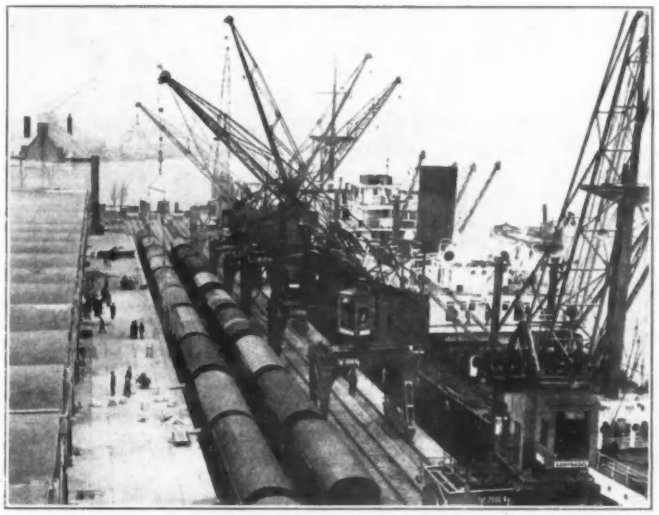


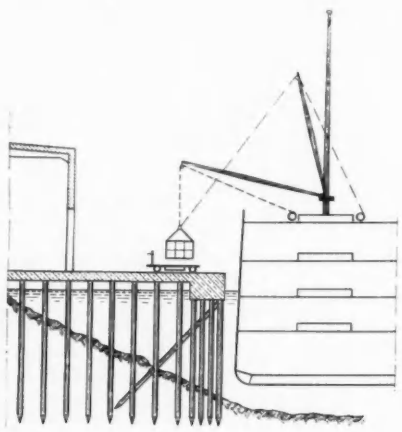
Fig. 3. German quay shed with three tracks on the quay apron and platform.

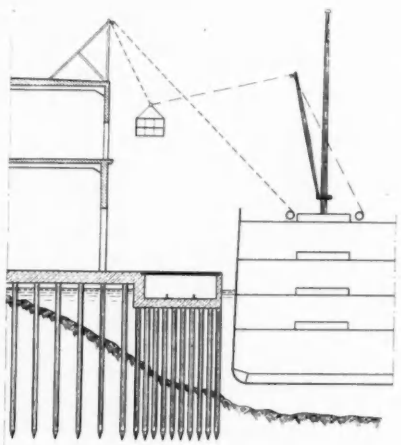
(3) **Influence upon the handling technique.**

For the **handling by ships' gear** usually two booms are required. One of them is slewed and fixed in the desired position, whereas the second heads over the hatch (Fig. 4). The movement of cargo out of the hatch on to the shore (or vice-versa) is performed by two falls connected to a cargo hook and movable independently. The fall hauling the load passes through a pulley at the end of the boom: it raises and lowers the load. The slewing fall effects the lateral movement of the hook. Two winches generally operated by two men are required for the action of either fall independent from each other. Seen from the side, the load travels along a flat curve over the ship's railings. Seen from above, it travels along a line, and provided the pendulum length of the hauling fall is sufficient, the load may be deposited on a strip of about 4 m. width. The farthest point to be reached on the quay is determined by the outreach of the boom; in no case will it exceed a distance of more than 7 m. from the quay wall. The area which may be covered on the quay by ships' gear and upon which the load may be deposited is thus no larger than 28 sq. m. At ebb tide the outreach of ships' gear over the quay is less than at high tide. At 7 m. outreach the most favourable conditions are given.

It is the practice in American ports to increase the outreach of ships' gear in order to cover wider quay aprons or to service upper

Handling of Cargo at European and U.S.A. Ports—continued





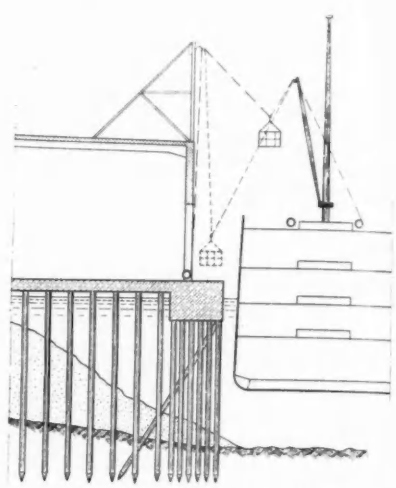


Fig. 4 *(left)*. Cargo handling by ships' gear only. Fig. 5 *(centre)*. Cargo handling with one quayside pulley (Burtoning system). Fig. 6 *(right)*. Burtoning system at New York with a quayside winch and quayside pulley.

shed storeys by leading the slewing fall, not via a pulley at the extremity of the boom, but rather via a pulley fixed to a cargo beam on the shed structure (Figs. 5 and 6). This improvement of the method of employment of the ships' gear, known as "burtoning," however, does not alter the lineal travel of the load in the horizontal plane in the least.

Luffing ships' cranes provide the ship with greater degree of flexibility when working with her own gear. However, the number of ships thus equipped is so small, for the time being on account of the high initial expense of this class of equipment, as to be of little importance when considering a fundamental solution of the problem.

The **flexibility of the quayside crane** considerably surpasses that of the ships' gear. Particularly the modern luffing crane, whose jib may be moved not only by slewing, but luffing also, and in some ports it is found that with an outreach of up to 36 m.—and with a minimum outreach of 8 m.—it can cover an area on the quay apron many times larger than in the case of the ships' gear. A semi-portal luffing crane wtih a maximum outreach of about 20 m. and a minimum outreach of 6 m is able to cover a quay area of about 700 square metres. The area shadowed by the structural parts of the crane has been deducted in this calculation.

The luffing crane offers many advantages on account of its greater flexibility, namely:—

(a) In the case of direct loading on the quay from ship into waggons or trucks several vehicles may be serviced at a time. If waggons stationed on two tracks are loaded, seven waggons altogether are reached by the crane. A large amount of marshalling work required in case of service by ships' gear can be saved and other traffic on the quay is spared any interference arising therefrom.

(b) In the case of indirect handling of cargo the crane lifts the cargo across the longitudinal traffic on the quay and deposits it immediately in front of the shed. With regard to the site of dropping the sling the crane has considerably more liberty than the ships' gear and the loading of electric trucks and other handling gear is much easier and does not interfere with longitudinal traffic of the quay.

(c) The simultaneous employment of shore cranes and ships' gear finally provides the possibility of meeting easily all requirements of handling, e.g. the crane (this is the practice particularly in Rotterdam)is able to work across and beyond the ship and to reach a series of several lighters alongside. In this case the ships' gear can work simultaneously on the off-shore and quay side. Cranes with large outreach frequently take care of the distribution of goods into lighters across the ship, work which the ships' gear is not able to perform on account of its limited stretch and its rigid load way.

Ships' gear and cranes can both work towards the quay, as is practiced in some English ports, which increases the handling capacity.

Furthermore, the ships' gear—this is standard practice in Germany—may be used foremost for the moving and trimming of cargo below deck, thus contributing considerably to the speed of the crane's work. In order to achieve specially high discharge efficiency the ships' gear can also co-operate with the shore crane by lifting loads on to the ship's deck from where the quayside crane removes them ashore.

The recent development of shed **handling gear and appliances** affords to the ships' gear valuable assistance in the form of fork-lift trucks, mobile cranes and similar gear. However, all this gear is not able to influence the capacity of the ships' gear since even a concentrated use of this kind of handling gear can move no more goods than have been deposited ashore by ships' gear or may be placed for stowage on the ship.

In ports with large differences of tide levels operators using ships' gear exclusively have been in many cases forced to employ **mobile cranes** to replace missing quayside cranes as the booms of smaller vessels cannot reach the quay apron at low water. However, since mobile cranes at work use the same traffic area as railway and truck the interference of the mobile cranes with other means of transport must be taken into account.

Road cranes of a large outreach may service ships with high freeboard and ships almost empty even at high water, however, the crane operator commands no direct view upon the hatch serviced by this crane. According to statements by American and Netherlands ships' officers, vessels loading and unloading cargo in Gulf ports suffered considerable damage to the timber lining of hatches and holds by the use of mobile cranes on account of the poor visibility of the crane operator.

Moreover, there are cases when the quayside cranes cannot be replaced by the ships' gear at all. This is the case when servicing inland water and harbour craft. Furthermore, in cases of very urgent dispatch the necessity frequently arises of employing more gangs in the loading and unloading operations of a ship than the corresponding ships' gear available. A careful investigation of such cases over a certain period in the Port of Hamburg showed that in 28% of all ships handled during this time the available boom of the ship would not have been sufficient. In all of these cases the employment of quayside cranes produced a very considerable acceleration of cargo operations.

It may once more be emphasised that, on the water side of the shed where traffic is most heavily massed in the immediate proximity of the ship during loading and unloading operations, the quayside crane brings order into the longitudinal and cross traffic on the quay by lifting **the cross traffic in a higher plane.**

Handling of Cargo at European and U.S.A. Ports—continued

Such methods correspond to the modern view of traffic development (example: Autobahn fly-over crossings over railways and other highways).—The quayside crane is capable of depositing cargo from above at any point inside its wide working radii and affords the simultaneous possibility of servicing land vehicles on the quay and or of depositing cargo immediately in front of the shed. The advantage, that the quayside crane can cover a considerably larger area of the quay than the ships' gear, becomes particularly valuable when cargoes have to be sorted during handling operations, i.e. if they are to be stowed on different vehicles as they come out of the ship. All this is feasible without any interference of the longitudinal traffic on the quay. The transport into the shed of cargo deposited in front of the shed does not interfere with any other means of transport because a shed equipped with quayside cranes offers sufficient liberty of movement, on either off-shore and water side, to road and rail vehicles which for this reason do not have to enter the shed.

Further, there are a number of ports in Europe which by tariff regulations levy special rates for distance zones. In the Port of Oslo, for instance, a premium is levied in cases where the distance between the point at which cargo discharged is deposited on the quay and the storage point within the shed surpasses 30 m. The productivity of cargo operations is therefore considerably increased by the use of quayside cranes which due to their larger outreach are capable of depositing the goods closer to the shed than ships' gear.

The interference to **transversal traffic** in the case of cargo being handled by ships' gear is the more serious, the wider the quay is. The apron of older American pier sheds is so narrow that besides cross traffic no longitudinal traffic is feasible on the waterside. The increasing cargo volume in the ports of the United States since the beginning of World War II, entailed that cargo handling could do no longer without longitudinal traffic on the water side. In consequence sheds built in the U.S.A. during the last few years or still under construction, have been provided with a quay apron of up to 15 m. width. The burtoning system does not help much to bridge this distance as American ports themselves use it very little to-day, and prefer to convey the cargo right on the apron from the edge of the quay to the shed, though by doing so they have to put up with the criss-crossing of longitudinal and transversal traffic on the quay. As cargo handling gear is flexible and efficient, and has been developed specially in the U.S.A. to a high degree of efficiency, it facilitates work by ships' gear considerably. It is a necessary supplement of the ships' gear in so far as it makes up for the latter's low outreach. However it is not able to increase the handling capacity of ships' gear.

The traffic on the quay apron resulting from the use of ships' gear is far more extensive and requires **equality of level** between quay and shed floor. Thus the possibility of servicing land vehicles on the water side by means of a platform is precluded. Almost 50% of length of platform possible around a shed is lost if—as this is U.S.A. practice—the platform is allowed on the land side only. If, moreover (as for example, in the Western European ports) the platform on the off-shore side is also removed or omitted respectively, no means at all are left to service waggons or trucks by platform. In either case the lifting of cargo to the height of the land vehicle's loading platform will have to be performed by other means, whereas this lifting is not required in the case of cargo handling by quayside crane, the cargo being then deposited on the higher level of the shed floor. **Lift trucks** are highly suitable for this lifting as they combine horizontal and vertical movement of cargo. This is one of the reasons which has promoted their widespread employment in ports which have no or few shed platforms. It is, of course, realised that in addition to this primary advantage they have been widely adopted on account of the saving in manual labour in stacking cargo.

Sheds with platforms on either off-shore and water side do not therefore so necessarily require to be equipped with lift trucks. The present practice so far in German sea ports proves this statement. If high stacking within the shed is required on account of lack of space the lift truck is used to advantage. In some European ports (e.g. Rotterdam) the lift truck is being introduced in large numbers. In other ports, this being the case in German sea ports, their introduction has been adopted only hesitatingly since their advantages are not so manifest as in American ports or other ports without platforms. No doubt the latter will in the near future employ more lift trucks than up to the present in order to make the most of valuable shed space by higher stacking.

A considerable **loss of useful shed space** arises by trucks being loaded and unloaded predominantly inside the shed in all localities where not platforms exist on the water side. The truck enters the modern sheds in the U.S.A. by wide openings on the short side. Inside the shed a correspondingly wide aisle must be kept clear for traffic and dispatch. This is lost to storage of cargo. The truck may, of course, also be parked and dispatched on the quay if this is sufficiently wide and transversal movement of cargo handling gear is not obstructed hereby.

Modern, mechanically driven handling gear, on its part, requires wider aisles for movement than the hand barrow. Lift trucks and mobile shed cranes require more liberty of movement than the electric truck. The useful storage space of a shed is also decreased hereby. It may be safely assumed that sheds with fully

Semi-gantry quay cranes at a berth, showing three-storied transit shed with verandahs and covered end space, all within reach of the quay cranes.

mechanised handling gear require aisles twice as wide as in sheds where cargo is handled by manual appliances.

In conclusion, the **advantages of the quayside crane** as compared with ships' gear plus cargo handling gear are as follows :

(a) the quayside crane lifts the transversal traffic into a higher plane;
(b) the quayside crane covers a considerably wider area on the quay;
(c) the quayside crane allows of platforms on the water side of the shed and thereby saves lifting work when servicing land vehicles;
(d) the shed inside is not required for truck (lorry) traffic. Aisles used for traffic inside the shed may be narrower, as modern handling gear requires more space for moving about;
(e) the quayside crane facilitates the servicing of harbour and inland water craft.

(4) Influence upon the handling output.

According to indications which have become known in Europe about American ports, it appears as if the specific handling output in tons per gang in the U.S.A. is higher than in Europe. When considering such output it should be remembered that, in regard to time needed for loading or discharging a ship, it is not the output of a single gang which decides this point but rather the **total output of all gangs working the ship.**

Investigations in German ports as to the handling output of ships relying exclusively on their own gear have led to the following results:

(continued at foot of following page)

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

English and Dutch Methods of Shore Protection

Adverting to the letter on the above subject in your May issue over the signature of the well-known maritime authority, Dr. Van Veen, of the Dutch Rijkswaterstaat, may I also ask the hospitality of your columns, as thereby readers who have not read my book on " Coast Erosion and Protection " may the more easily appreciate the argument. First of all, I should like to clear the ground by assuring the worthy Doctor that my approach to maritime matters is with humility and never scorn. The paragraphs, pages 221 and 222, of my book from which he quotes a few sentences read as follows :—

" The sandy foreshores of the Low Countries have for centuries been given careful and constant attention, and the fame of the engineers concerned is widespread. It was always opined that the outstanding feature of these important coastal protection works was the resourceful utilisation of cheap and readily acquired materials, yet the modern tendency on these shores during the last few decades has changed considerably. The constructions become more and more grandiose and expensive; in fact, viewed against the history of the simple early works of generations ago, it does not appear that these modern methods have even the functional success of their forerunners. It is only right that new works and methods should be tried out, but they must be more closely related to the ends in view, and the natural conditions, than to the material characteristics of the construction: for example, the construction of the Scheveningen groynes was a formidable undertaking.

" On a 12-mile stretch of coast north of the Hook of Holland there are 66 groynes extending for about 330-ft. below low water line. The cross section of these groynes shows that they are about 80-ft. wide and about 12-ft. high from the base to the crest. The central body consists of a tier of fascine mattresses tapering from nearly 80-ft. wide on the bottom to 30-ft. at the top. On the top fascine a straw mattress is laid and staked, and then covered with a blanket of rubble to a humped form. Over this, for a central width of 20-ft., basalt blocks are laid, and confined at the outer edges with heavy timber stakes. Then on the outside of the stakes, large rubble is tipped to completely cover the whole of the fascine mattresses projecting beyond the basalt crest, at both sides. This rubble is then grouted with bitumen mastic of 20 per cent. bitumen, 60—70 penetration, 10 per cent. filler, and 70 per cent. dune sand, poured at temperature of 180 degrees Centigrade.

" The groynes so treated remained in good condition for six years without maintenance, but those which were not grouted suffered considerable damage.

" Now, as the foreshore is of fine sand and there are no sandbanks off-shore for a considerable distance, the question arises, are the functional benefits obtained from these massive structures commensurate with the cost? The overall problem of this coastline is without doubt best understood by the coastal engineers but, as far as sand accretion is concerned, in *no way has a case been made out* for solid obstructions opposed to wave or current. It is much more likely that large solid obstructions will accelerate sand transportation by prolonging the time the grains remain in suspension under wave action and subjected to current movement, and thus promote local scour and settlement of the groynes. If the turbulence about them is sufficient to scatter the rubble, then it is obvious there will be no deposit or accretion of sand grains. As each of these Scheveningen groynes cost between £20,000 and £25,000, it will be appreciated that such works cannot lightly be undertaken."

Surely this is a fair comment in view of the fact that elsewhere on the sandy west coast of Denmark similar heavy groynes of concrete blockwork have not given the degree of efficiency commensurate to their cost. For example, on a 4½-mile stretch of coast south of Bovbjaerg the coast recession before groyning was 10-ft. per year. After the construction of the groynes the erosion was eventually reduced to 3-ft. per year but, unfortunately, in the immediate lee of the series, the coastline for a considerable distance (originally stable and comprising valuable agricultural land with cliffs of moraine clay 30—40-ft. high) suffered the severe erosion of 200—250-ft. in ten years.

Another factor proved alike by the Danish and Dutch engineers was the high cost of maintaining the seaward extremities of these structures; in fact, while the Dutch were forced to bind the boulders with bitumen into a cohesive mass, the Danes were compelled to shorten their groynes by 300-ft. Further, the settlement rate of the groynes into the sand entails a considerable renewal every ten years or so. Many other examples of a similar nature show the hazards attendant on massive groynes or " strong capes."

Dr. Van Veen's explanation that these capes were constructed with the sole intention to throw the tidal currents further out to sea, with the full acceptance of the consequent loss of any available littoral drift, constitutes probably the most daring expedient to reduce erosion that has ever been devised. I sincerely hope it shows good measure of success. My doubts, however, arise from the conviction that an onshore gale and conditions of the sea bed that make for wave convergence create severe turbulence and out-to-sea under currents of strong erosive power. Against this, groynes, or capes, alone, are of little use.

Much as I admire the maritime skill and wide knowledge of Dr. Van Veen I cannot subscribe to his penultimate sentence, I quote, " Of one thing we are sure; there is no other way to stop sea erosion than by making or keeping strong capes."

I would like to emphasise that what I have written above is the portrayal of my thoughts and is not fault-finding criticism of his helpful letter nor yet solely justification for statements in my book. I am as keen as Dr. van Veen to arrive at reasonably effective practical solutions of sea problems within the economy of social values and logical geophysical limits.

Yours faithfully,

13, Mendip Gardens,
Bath, Somerset.

R. R. MINIKIN.

Handling of Cargo at European and U.S.A. Ports

continued

(a) Hardly more than 50 per cent. of all present day ships dispose of sufficient booms as to be worked by more than 5 gangs.

(b) Even in the case of modern ships equipped with a larger number of booms, these are generally working to full handling capacity with 5 gangs, as part of the winches have to be employed for shifting cargo below deck.

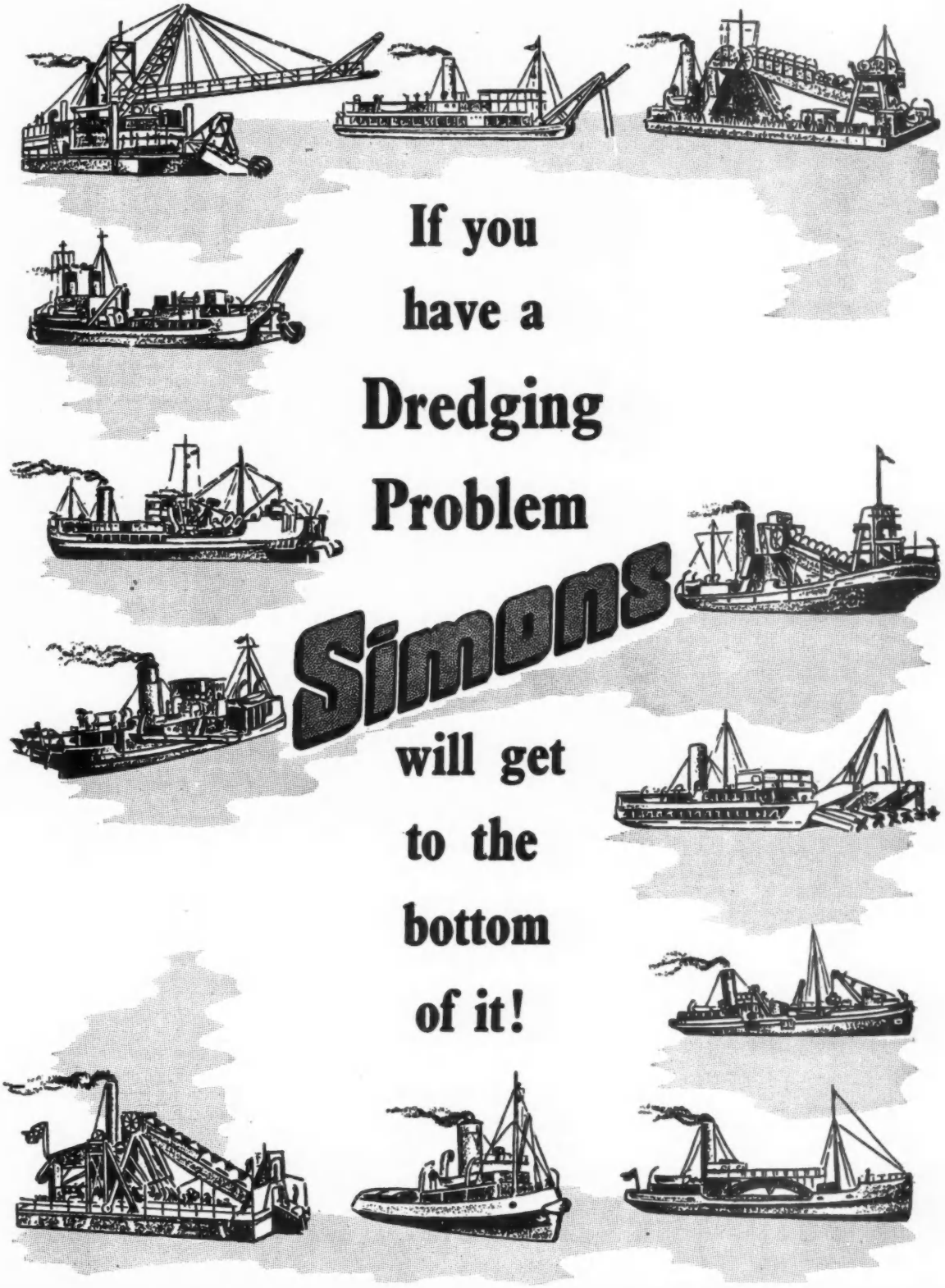
If quayside cranes are available for the handling of cargo the picture is as follows:

(a) If the ship and the hatches are large enough a number of up to 13 gangs may be working to the shore.

(b) In addition the ship can work simultaneously a further 5 gangs on the off-shore side into floating craft and still has available a sufficient number of winches for the shifting or stowage of cargo below the deck.

The above figures agree with the practical experience that the loading and unloading of ships in European ports is performed **considerably faster** than in U.S.A. ports. Reports from ships' officers and port operators tell that, by the use of quayside cranes the handling output of a ship is increased by 50-70 per cent. as compared with the exclusive employment of ships' gear. This, after all, is the decisive point of our study, since by faster dispatch of the ship the quayside cranes fulfil their foremost task: to contribute in setting the ship free for its true purpose, i.e. moving across the seas. Thus the use of cranes increases the productivity of the whole operation and promotes the business of the port. Unavoidable demurrage of the ship is of no account for the comparison of quayside cranes with ships' gear as either means of cargo handling is affected in the same degree.

(To be continued)



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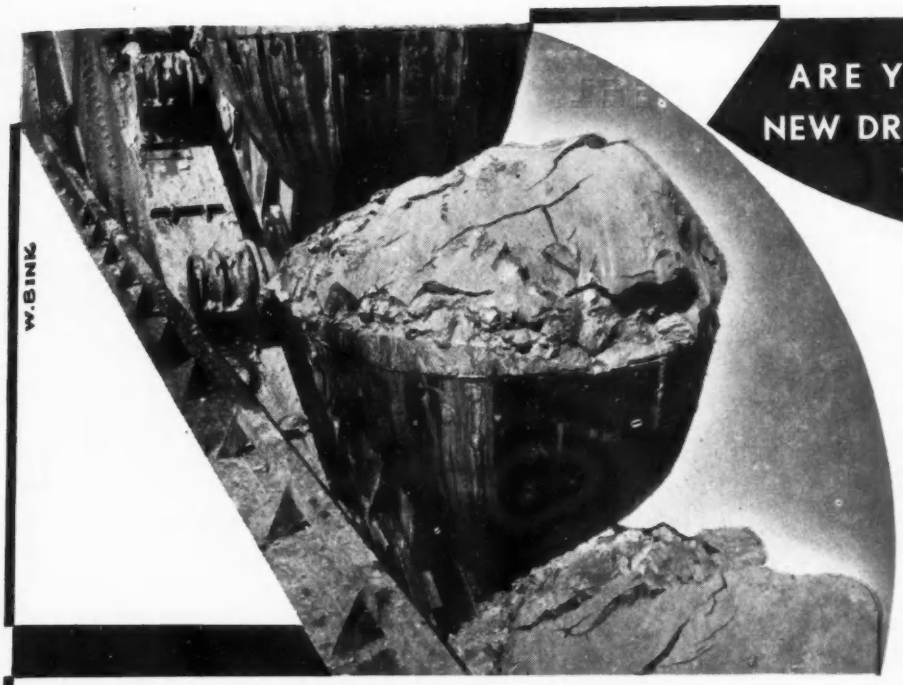

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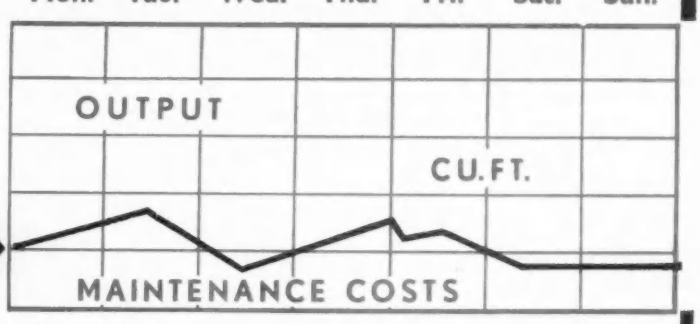

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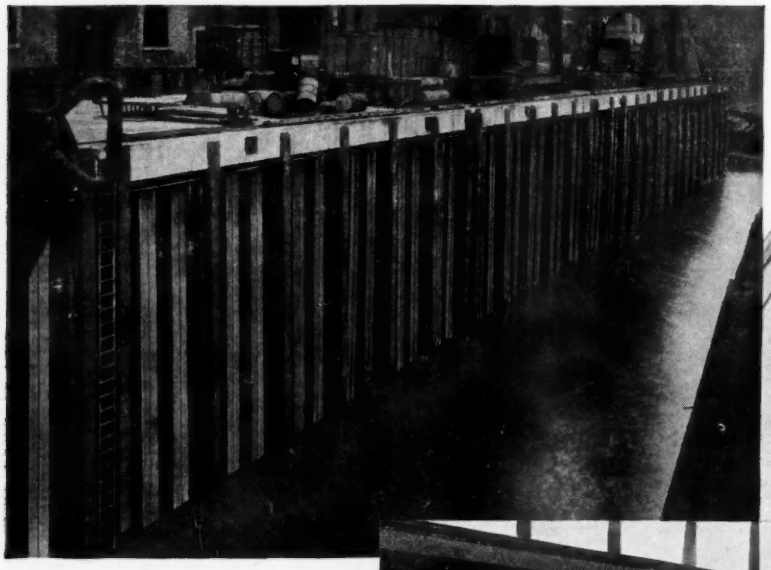
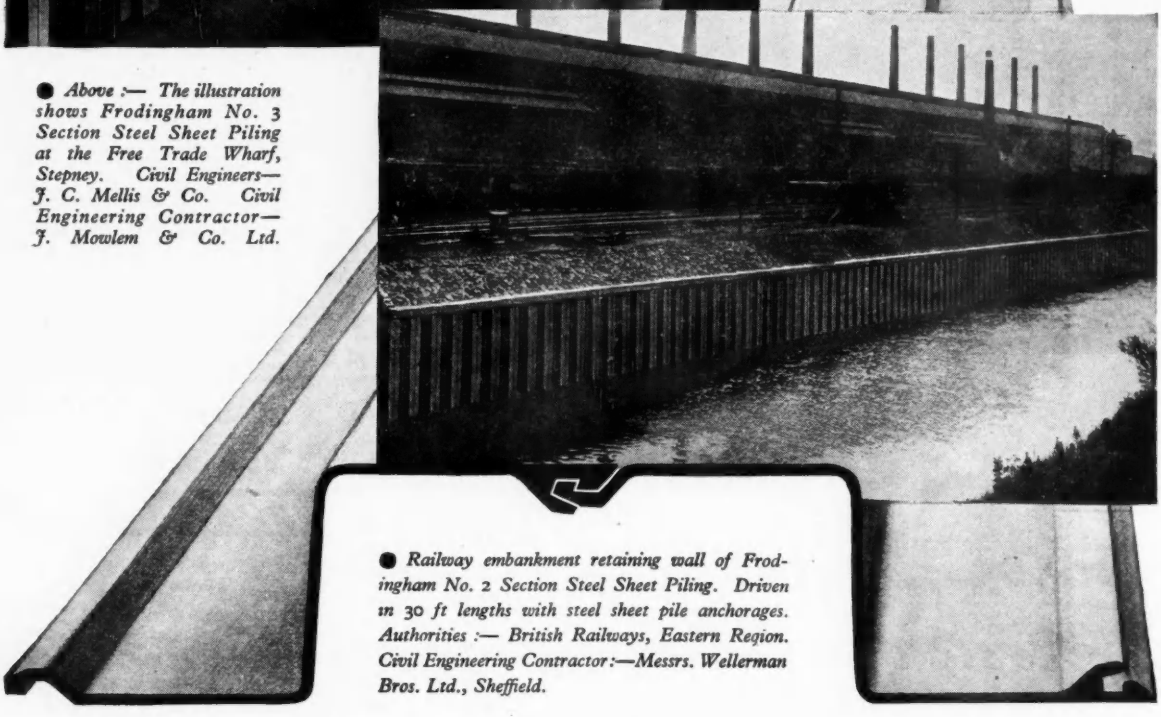


● *Above :— The illustration shows Frodingham No. 3 Section Steel Sheet Piling at the Free Trade Wharf, Stepney. Civil Engineers— J. C. Mellis & Co. Civil Engineering Contractor— J. Mowlem & Co. Ltd.*



● *Railway embankment retaining wall of Frodingham No. 2 Section Steel Sheet Piling. Driven in 30 ft lengths with steel sheet pile anchorages. Authorities :— British Railways, Eastern Region. Civil Engineering Contractor:—Messrs. Wellerman Bros. Ltd., Sheffield.*

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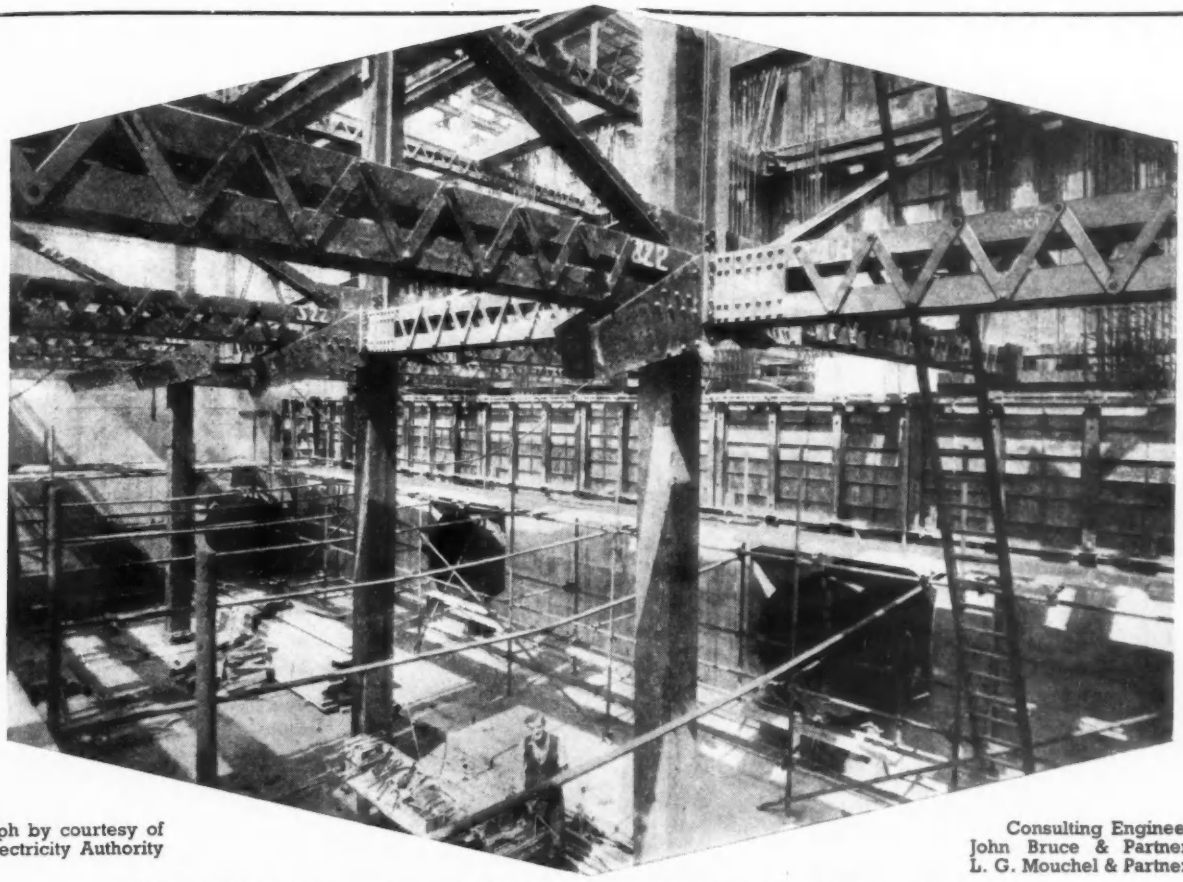

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The Lay-Out of Dock Railways

An Important Adjunct to Efficient Port Working

By HENRY F. CORNICK, M.C., M.I.C.E.

(continued from page 11)

Tracks laid on Quays.

The rail tracks on quays are sometimes laid on wooden sleepers and crossing timbers, but more usually, on a mat of reinforced concrete about 8 inches thick. After laying, they are filled in to the level of the top of the rails, either with concrete, tarmacadam, or granite setts. This practice ensures that the railways offer no obstacle to the free passage of road vehicles and foot traffic.

The tracks are "guarded" throughout, usually with either rails or bulb angles but occasionally with rolled steel channels, so as to keep the flangeway grooves free from obstruction. On curves and through points and crossings, rails are generally used for this purpose, possessing as they do a greater bulk of material to take the wear and tear, and being composed of harder steel than either angles or channels.

The guards are bolted to the running rails with cast iron blocks at approximately 2 feet 6 inches to 3 feet centres, while at about every third block the bolt is omitted and a gauge tie-bar substituted for it.

The track does not often need holding down if it forms part of a concreted road, as the rail flanges give it sufficient anchorage to counteract any tendency to lift. If, however, the road is to be surfaced with granite or blue brick setts, the rails need to be held down either to the concrete base or to wooden sleepers with foundation bolts or coachscrews and clips respectively.

For easy maintenance and renewal, the tracks when laid in paving are sometimes laid in a "chase" or channel left in the surface, in which, after laying and packing to correct line and level, they are anchored, and the roadway is completed by tarmacadam. Such material is relatively easily removed when renewal of the tracks is required. It is important, however, that the "chase" or channel should span the whole width of the gauge, so as to permit the use of the necessary tie-bars without the expense of cutting transverse channels for their insertion.

In practice the top of the rail head stands proud of the road surface by about ¼ inch. This allows for some wear taking place in the rail before the point at which the outside edge of the wheel flanges begin to bite into the concrete, and delays the consequent slight defacement of the road surface adjacent to the rails.

Fig. 8 shows a typical cross section of a curved guarded track laid on a concrete quay. The space between the check rails may be filled with tarmacadam and likewise a space 6 inches or so wide on the outside of each running rail. Alternatively, weak concrete, for ease of maintenance, surfaced with granolithic may be used for this purpose. The only criticism which may be made of this design is that the tarmac sometimes depresses or wears down thus forming ridges which are objectionable for trucking purposes. The remedy, however, is simple, i.e. regular maintenance. The space between check rail and running rail is sometimes filled with concrete up to the level of the distance blocks, and at intervals a space is left between two check blocks so that water may drain down through a cut-away in the flange of the guard rail, down a pipe through the concrete deck or quay surface and so away into the subsoil. The provision of drainage to this space in running rails, however, is often unsatisfactory, for debris may quickly block it up, and it is often better to run in the space to above the distance blocks, with some impermeable material such as sand and bitumen.

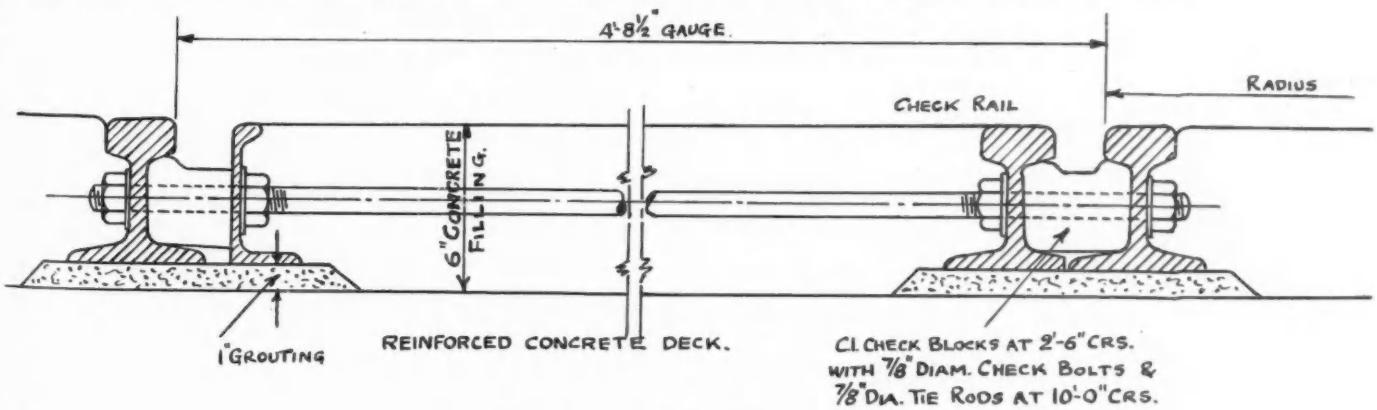
In any case, however, it is desirable to drain the spaces at tongue rails, and special precautions must be taken to avoid blockage.

Frequently, in quayside railways, the 4 feet 8½ inches gauge tracks are intersected by wide gauge crane tracks. Such cranes have either centre-flanged wheels necessitating track that is composed of two rails, or double-flanged wheels calling for a single rail with a guard on either side of it. The points of intersection between the 4 feet 8½ inches gauge tracks and the crane tracks cause special complications in design; but most docks have some of them in their quay layouts.

Fig. 9 shows a cross section of a crane track laid on a concrete quay with a tarmac surface, while Fig. 10 is a photograph of a double-flanged crane wheel crossing designed and cast in Imperial manganese steel by Messrs. Edgar Allen and Co., Ltd., Sheffield. Fig. 11 illustrates a section of a similar type of crane crossing, in this case fabricated from medium manganese rails and steel plates, by Messrs. Thos. Summerson and Sons Ltd.

Sleepers and Ballast.

The railways behind the wharves themselves, namely those which connect the tracks on the wharves, quays and jetties with the main lines of British Railways, are usually laid on wooden sleepers and crossing timbers on ballast, are not guarded, and are not rendered obstructionless to road and foot traffic. There is nothing out of the ordinary in their design, which follows pretty closely the standard practice of British Railways.


4'-8½" GAUGE.
RADIUS
CHECK RAIL
6" CONCRETE FILLING.
1" GROUTING
REINFORCED CONCRETE DECK.
CI. CHECK BLOCKS AT 2'-6" CRS. WITH 7/8" DIAM. CHECK BOLTS & 7/8" DIA. TIE RODS AT 10'-0" CRS.

SECTION OF CURVED GUARDED TRACK.

RAILS 75 LBS. FBBS. REV'D. SECT.

Fig. 8. Typical quayside guarded curved track in concrete.

The Lay-Out of Dock Railways—continued

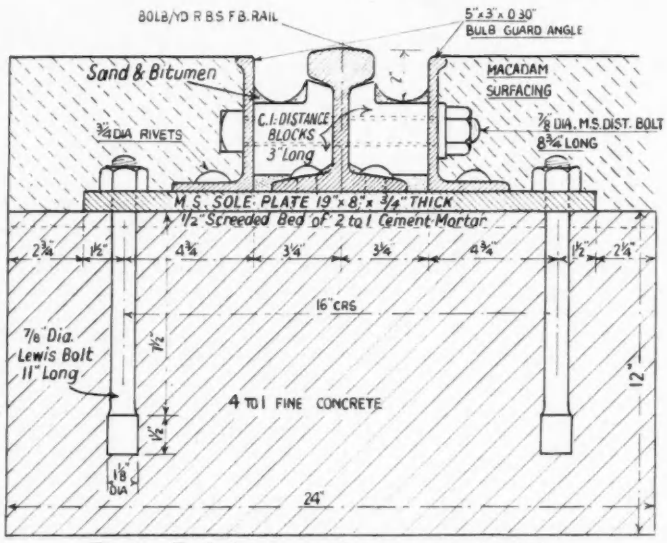


Fig. 9. Typical crane track on concrete foundation.

Sleepers are usually of timber of 10 inches by 5 inches section. Crossing timbers are of either 12 inches by 6 inches or 14 inches by 7 inches sections under turnouts and switch and crossing layouts. The Standard British timber sleeper is now 8 feet 6 inches long. The cellular nature of soft wood sleepers is gradually destroyed by continual subjection to heavy pressure; consequently track carrying traffic of great density requires to be carried by sleepers at closer spacing than that subjected to lighter loading. Again, too great a spacing or too long a bearing of the rails on sleepers, as for example in rails without bearing plates, causes them to rock. In general the normal spacing varies from 2 feet for heavy to 2 feet 7 inches for light traffic densities, while the joint sleepers should not be more than 0.60 of the distance of the intermediate sleepers. Holes bored for spikes should be about half the diameter of the spike or coach bolt in soft wood sleepers, but may be increased in hard wood sleepers, while the spikes or coach bolts are sometimes not driven hard on to the flanges of the rails, to avoid the slight deflection of the rails under load causing a withdrawing action.

In normal times Baltic Redwood or Douglas Fir creosoted timber sleepers were largely used on main line permanent way and in docks. During and after the War, home-grown hardwood timber was used extensively some varieties of which could be creosoted.

Due, however, to the general shortage of timber, reinforced concrete and pre-stressed reinforced concrete sleepers and sleeper blocks are sometimes used in the sidings of Dock and Harbour Authorities. These sleepers demand a method of packing the ballast which differs from that used with wooden sleepers, a channel of loosely packed ballast being left down the centre of the track. Steel sleepers have been used extensively in many parts of India and elsewhere and have given fairly satisfactory service. They also have been used by British Railways on certain sections of permanent way, but have never, to the author's knowledge, been used in the United Kingdom as standard practice on dock railway systems.

British Standard Specification No. 986—1944, covers the manufacture of concrete sleepers, reinforced concrete sleepers and sleeper blocks for both bull-head and flat bottom rails for use in sidings, goods traffic lines, etc., where speeds are less than 30 miles per hour, and is applicable to the requirements of dock railways. The specification also provides for the requirements of pre-stressed concrete sleepers and various methods of fastening the rails or chairs to each variety.

Of pre-stressed reinforced concrete sleepers there are several proprietory patents; one example is the " Freyssi " perfected by Mons. Eugene Freyssinet, which is of very high quality concrete provided with continuous loops of small gauge wire of high elastic limit which are wound within the concrete, the ends of the loops being afterwards entirely covered with concrete after pre-stressing, and hardening of the sleeper. Another type is the Dow-Mac patented pre-stressed concrete sleeper. These are manufactured by the Dow-Mac (Products) Ltd., Tallington, and designed by the Pre-stressed Concrete Co., Ltd. These sleepers contain ten or so high tensile steel wires, and in the process of manufacture these wires are tensioned in long lengths, the sleeper moulds being placed around the wires, with space between them longitudinally, the concrete is vibrated, allowed to harden, when the wires are severed in the spaces, and the ends sealed in concrete.

The purpose of ballasting is fourfold, i.e., to distribute the load over the formation; to provide a resilient layer between the sleepers and the formation; to hold the sleepers in position; and lastly, to secure rapid drainage of surface water. Current practice is to lay a " bottom " on the formation consisting of 6 to 9 inches of stone, slag, sand or ashes according to the type of ground. On this the top ballast, to a depth of 3 inches is laid consisting of gravel, slag, granite or other stone. Upon this the sleepers are laid, the ballast being finally made up to the level of their tops, and extended some 12 to 18 inches beyond the end of the sleepers. The usual size of stone for the top ballast is from ½ inch to 2½ inches, voids increase drainage and angular stones provide the best binding properties. In many situations in docks, ashes from which dust and fine stuff has been screened are largely used. Adequate drainage of tracks is essential and to ensure this, the top ballast should be periodically removed, screened and replaced.

While permanent way perfection is neither attainable nor essential on dock railway systems, the general principles of main line work provide the basis upon which both design and maintenance are based, and must, of course, be more nearly approached where main line passenger rolling stock regularly uses sections of dock railways.

Curved Track.

The radii of curves in dock railways vary between 1½ chains and 10 chains. It is clearly advisable to design curves of as great a radius as circumstances will permit. It should be borne in mind that British Railways specify a minimum radius of 7 chains for tracks over which their heavy locomotives are required to run, but occasionally will allow short wheel base tank locomotives to operate on 5 chains radius curves.

An adequate length of straight track should always be provided between reverse curves, although it is not always possible in all crossovers. The tongue rail of a switch, in effect, forms the

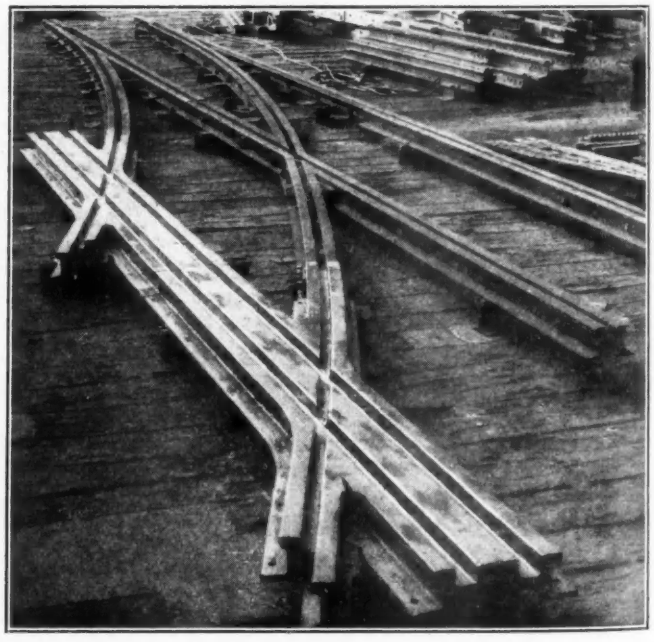


Fig 10. Crane track and railway crossing, cast in Imperial manganese steel.

The Lay-out of Dock Railways—continued

straight between the two tracks, the main one of which, however, may be of course straight. The transition curve or easement spiral of main line railway practice, inserted between a tangent and a circular curve or between two curves on the same hand for the purpose of attaining gradual radial acceleration, is not normally necessary in dock railway systems.

It is good practice when laying curved tracks of less than 3 chains radius, to lay them wide to gauge by up to as much as $\frac{3}{4}$ inch, the dimension varying with the radius and the class of traffic, for example from 7 to 10 chains it may be $\frac{1}{2}$ to $\frac{1}{4}$ inch. A check rail on the low side of curves of less than 120 feet radius should be fitted so as to ensure that traffic will negotiate the curve without danger of derailment. The desirability of using bearing plates on all curved track has already been mentioned.

The effect of centrifugal force on rolling stock passing round a a curve is not usually of very great importance in dock railways owing to the moderate speed of trains. It is usually counteracted partially by raising the outer rail of the curve above the level of the inner rail. The smaller the radius of the curve the greater is the super elevation required, the exact amount is not critical but it is essential that it is reached gradually from the level.

A true formula for calculating the super elevation E in inches to counteract the centrifugal force of a moving train is as follows:

$$E = \frac{G \times V^2}{32.2\ R}$$

Where G = the gauge of track in inches, V = the velocity in feet per second, and R = the radius of the curve in feet.

In dock railway practice, much less than the amount so obtained is provided, in some cases only three quarters of it. The practice in some instances of providing none at all should be avoided, for super elevation greatly eases the negotiation of curves, reduces wear, and adds of the comfort of personnel on trains.

Points and Crossings.

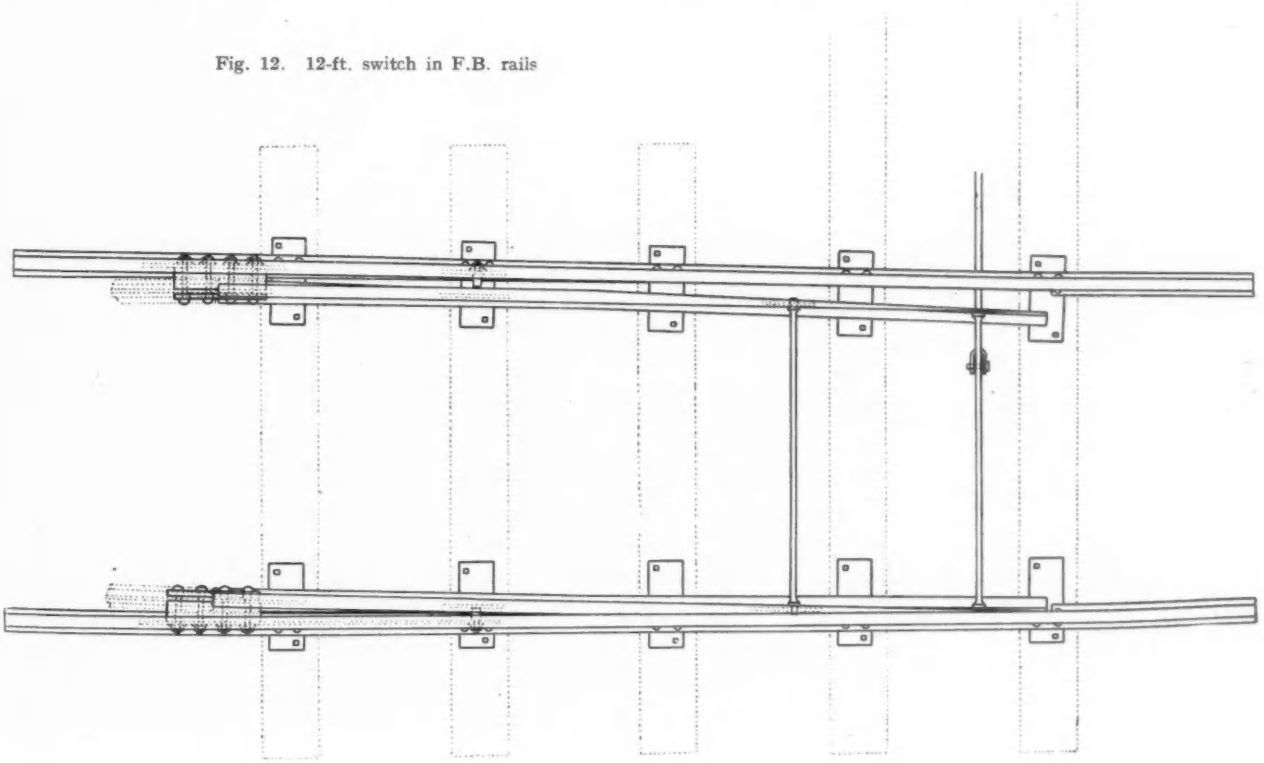
All the usual forms on main line tracks may be met with on dock railways, from the simple turnout to the complicated outside double slip. The most common special fitments on quays are the ordinary turnout, single and double junction, the crossover road and scissors crossover.

Fig. 11. Crane track and railway crossing fabricated from medium manganese rails and steel plates.

A typical 12 feet switch for a turnout in F.B. rail is illustrated in Fig. 12, which is reproduced from a drawing supplied by Messrs. Thos. Summerson and Sons, Ltd. The switch shown has the minimum possible length of stock rail, the normal length for ordinary purposes would be some 3 feet longer.

There are three types of switch, i.e. straight throughout its

Fig. 12. 12-ft. switch in F.B. rails



The Lay-out of Dock Railways—continued

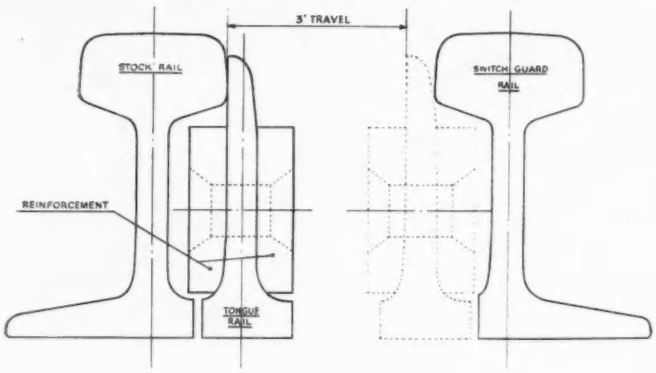


Fig. 13. A special type of reinforced tongue rail.

length, curved throughout, or straight for some distance from the toe and then curved. Likewise there must necessarily be an infinite number of layouts of junctions, crossings, crossovers, and so on, due to varying dimensions angles and divergencies dictated by the requirements of the site. The dimensional problems involved in the design of the fitments may all be solved by more or less standard rules, but with elaborate layouts it is often necessary to set them out accurately to a good scale. There are available many text-books devoted to railway engineering, which should be in every dock engineer's library.

When guarded turnouts are used in quay layouts, a special feature of good design is the close guarding of the points of the switches so that the gap at the switch points, while sufficiently large to allow the switch tongue rail to travel, is small enough to prevent pedestrians from having their feet trapped in it. A special type of reinforced tongue rail has been designed for use at such positions which allows a gap of only $2\frac{1}{2}$ to $3\frac{1}{8}$ inch from the heel to the toe of the tongue rail. Fig. 13 supplied by Thos. Summerson and Sons illustrates this reinforcement which gives full strength to the tongue rail while allowing a minimum gap.

Fig. 14 is a photograph supplied by Messrs. Edgar Allen and Co., Ltd., Sheffield, of a scissors crossover constructed by them for a United Kingdom quay layout, with 126.2 lbs. ordinary steel grooved rail. This type of rail is particularly applicable wherever tracks and crossings have to be laid with the road levelled for vehicular traffic, for the reasons already stated.

Tracks which are to be laid fitted with guards, whether rails, angles or channels, are almost invariably supplied by the manufacturers in the pre-assembled condition. Unguarded tracks are not usually supplied pre-assembled, however, as there is not enough storage area in docks to allow for stacking this type of track laid on its sleepers, as each piece would be 36 feet to 60 feet long by 9 feet wide by 10 to 12 inches deep. The rails and other items are, therefore, delivered separately and are assembled on the site.

Signalling Lever Boxes.

In most dock railway systems the application of semaphore (or colour light signals) operated from signal boxes is limited in scope to possibly one or more important tracks. It is usual, however, for passing trains of goods or passenger stock into, and out of, the dock premises from, and to, the main line, to have a signal box controlling this operation and the marshalling yard generally, in direct communication with the main line signal box. A description of various British systems of working marshalling yards appeared in " The Engineer " of July 10, 1942. Opening bridges over locks and passages, traversed by railway lines are usually protected by signals connected to the bridge opening and closing gear.

In certain docks where main line passenger traffic runs over the dock railways, the switches are operated from a central signalling box which also controls a signalling system limited to those

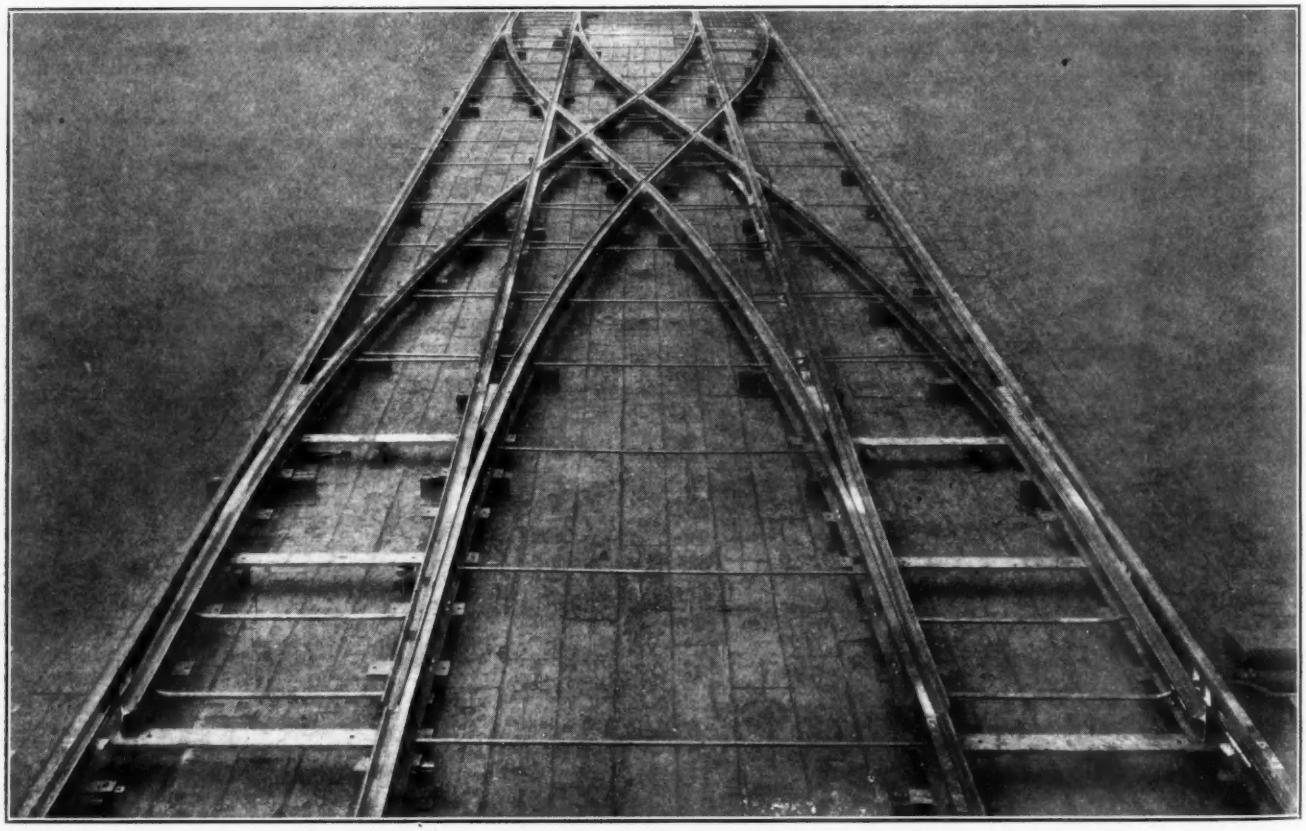


Fig. 14. Scissors crossover for dock sidings in 126.2 lbs. grooved rail.

The Lay-out of Dock Railways—continued

particular tracks, and as on main passenger lines, all facing points comply with the regulation that they must be fitted with a bolt lock and locking bar or other approved safety device, to ensure that the switch blades are bolted to the stock rails before the train can be signalled to proceed. The locking of facing points is, of course, necessary where point rodding is actuated by hand operated lever boxes and is accomplished by special locking cups inserted before the passenger train is " flagged " on.

In the majority of docks, the hand operated lever box is employed, many patterns of which are supplied by the manufacturers of railway accessories. On tracks other than those situated on quays or cartage areas, the type mostly used is the weighted lever variety. Fig. 15 shows two types supplied by Messrs. Thos. W. Ward Ltd., but there also are types of spring loaded lever boxes. In sorting sidings, for example, and where a switch line is less frequently used, automatic reversing switches are sometimes desirable. In applying the toggle spring principle for this purpose, the difficulty is sometimes encountered that, if the toggle spring is powerful enough to close very heavy switches, the resistance it offers to reversal by hand power tends to be more than can be overcome by a man of ordinary physique.

To overcome this disadvantage, several types of lever box have been evolved by manufacturers.

It is only possible to give in these notes details of one type and that selected is manufactured by Thos. Summerson and Sons, Ltd. Fig. 16a illustrates the " David " spring-acting lever box which has an upright handle and can be used where an obstructionless lever box is not required.

In regard to railways laid on quaysides and cartage areas, such tracks are usually entirely obstructionless, the lever boxes which operate the switches being of the type which has cranked or jointed levers, and these, when not in use, lie in channels beneath the surface of the road. Fig. 16b shows the spring actuated lever principle applied for use with switches laid in paved or concrete areas where an obstructionless box is necessary. With both the above-mentioned boxes, the hand lever remains still when traffic is " trailing " through the points and they can be supplied for either one-way or two-way operation. The switch rodding is enclosed in suitable cover boxes, the lids of which can be raised for maintenance or adjustment.

The requirements of rodding beneath the surface in complicated layouts pose a number of difficulties in design, necessitating the use of special cover boxes, roller stands and bellcranks, but in general lever rods, connecting rods, bellcrank and stands, etc. are of standard dimensions.

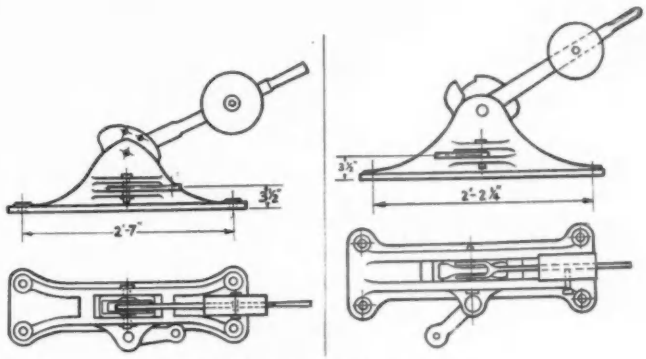


Fig 15. Weighted lever boxes.

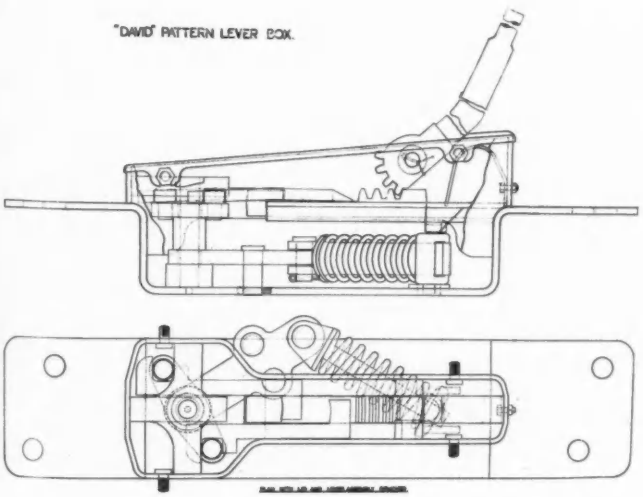
Maintenance of Dock Railways.

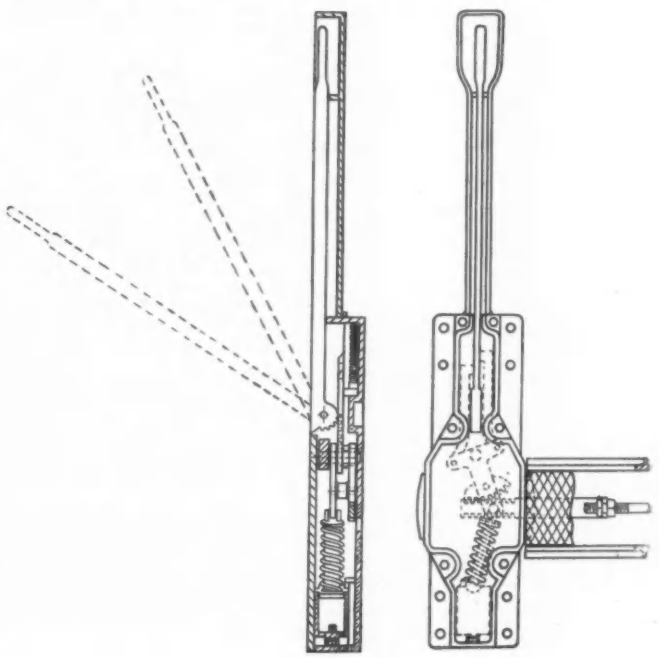
There are many ways in which the life of the tracks may be lengthened, which, with freedom from accidents due to track defects, is the essence of efficient maintenance. Assuming that the design and layout of the track with its various turnouts, crossovers, curves and slips, etc. is sound, perhaps the most important single item is good drainage of the foundation and ballast. Regular attention must, therefore, be bestowed upon the drains and surface water channels, particularly prior to the wet seasons, also the ballast must be kept free from dirt and weeds.

Of almost equal importance, but greatly dependent upon good drainage, especially with clayey or impervious formations, is the maintenance of good level, alignment and gauge. The working efficiency of heels and toes and slide chairs of switches, together with the point rods and lever boxes is, of course, essential. It is at switches where 75 per cent. of any derailments occur, and a system of regular oiling and examination is part of the normal routine on every dock system; constituting the only moving parts in the tracks, efficient attention here will save many costly renewals.

On dock railway systems the curves in many places may be of somewhat small radii and a good deal of wear takes place on both rails and checks, but regular greasing assists in reducing it. Incidentally, screeching and grinding wherever it is heard from traffic passing round curves is a sure sign of undue wear.

Fig. 16. Spring-loaded lever boxes.
a *(below)* Ordinary type.
b *(right)* Obstructionless type.





TheLay-out of Dock Railways—continued

In certain docks, some form of automatic lubricator is employed. These are fitted to the outer and check rails, graphite grease being forced on to the sides of the rails by means of small plunger pumps actuated by the flanges of the wheels of the locomotives and waggons passing. An efficient rail and flange lubricating machine, of which there are several on the market, will easily add 50 per cent. to the lives of the rails.

Resurfacing of worn switch and crossing rails by welding in situ is now practically universal on main line railways, and the practice is becoming deservedly popular on dock systems. The process favoured is the oxy-acetylene method; it is less expensive than a portable electric arc-welding plant.

With regard to weed killing, in docks situated in built-up areas, this does not constitute a great problem, but in those in rural areas or where there are areas of land set aside for development, as for example, Tilbury Docks, Essex, the growth of weeds and their destruction presents a subject of some importance.

Its solution lies in the regular cutting of the grass on vacant land and the destruction of the weeds on the railways before the seeds are ripe. Weeds on railway tracks, if in large quantities, are best destroyed by spraying with chemical weed killer, or if not in great numbers, by the use of the spade, hoe or fork. Incidentally, the advent of weeds in the ballast of tracks indicates the presence of dirt and mould and screening or renewal of ballast should be carried out.

Our attention has been directed to an error in the concluding paragraph of the May instalment of this article. The word " makers " should read " distributors." We are also reminded that the makers of the " Elastic " Rail Spike are Elasteel Ltd., of Worksop, England.

We also have been asked to point out that in the May issue the section of Flat Bottom Rail used by the Mersey Docks and Harbour Board is quoted as 90 lbs. per yard. This section is not used by the Board, however, the weights normally being 75, 110 and 109.1 lbs. per yard, the 110 being now, of course, discarded in favour of the 109.1. In all quays, avenues, crossings, etc., where a level road is required, the 126.2 lbs. per yard Tramway Section is adopted. The 95 lbs. per yard Bull-Head Section formerly in use in the Board's Birkenhead Dock System is being relaid in 109.1 lbs. per yard Flat Bottom.

Book Reviews

Breakers and Beach Erosions by Tokuichi Hamada. Report No. 1 of the Transportation Technical Research Institute. Published by the Unyu-Gijutsu Kenkyujo, Mejiro, Toshimaku, Tokyo, Japan. Dec., 1951. No indication of price.

This is a study of beach erosion problems. There are 165 pages of text, 38 diagrams and 61 photographs.

The essential feature of Mr. Hamada's study appears to be an analysis of breaker action into a complex of flow and wave, including mass transportation, return flow and one shoreward and two reverse vortices. The resulting accretion and scour are observed and deduced. Fig. 30 shows the general principles adopted.

Starting with a chapter on the " Properties of breakers," he commences with a statement of the classical theory of progressive waves, followed by a good summary of recent work and some practical analyses of Japanese investigators. Then comes a chapter on the formation of breakers, including remarks on permanent type progressive waves of finite height and shallow water waves.

There then follows a statement of the notation adopted, and forty-six references.

The second part deals with actual experiments made in Japan. Firstly, there are stated his conclusions as to the general properties of breaking waves and some notes as to peculiarities of breakers and surf, followed by a study of the momentum transport of progressive waves and nearshore wind effect.

Lastly observation of actual beach erosion.

Thirty-eight references then follow. These seem to be fairly exhaustive and include Mr. Minikin's papers of recent times which appeared in the " Dock and Harbour Authority " on the subject of coast erosion.

The model in which the experimental work was carried out was 22 metres long, 0.6 metres wide and 0.55 metres deep. The model was placed under a wind tunnel, capable of producing a velocity of 15 metres per second. The water depth actually used was 30 centimetres, the wave heights from 1 to 12 centimetres and the periods 0.6 to 3.0 seconds. The beach at the end of the model had slopes of 1/10 and 1/15. The work was done between May 1950 and February 1951.

This seems to be a praiseworthy effort and justice is done to the numerous investigators who have studied this subject. The names of S. Sato, H. Matsuo, M. Nakano, S. Hayami and R. Nomitsu are mentioned in the references and acknowledgments are made to Dr. M. Honma, Dr. K. Aki, and Messrs. A. Shibayama, Y. Haranaka and H. Taniguchi.

The author quite rightly emphasizes the importance of the initial steepness of the waves at breaking time, and freely admits that a number of questions are left unanswered.

An inset of slight corrections to some of the formulae is inserted. The author's English is not always of the clearest but on the whole is very good and we hope to see some more of his work.

H.C.

Waves and Tides by R. C. H. Russell, M.A., and Commander D. H. Macmillan, R.N.R., F.R.I.C.S., A.I.N.A. 348 pp., over 100 line drawings and 17 photographs, 25s. Hutchinson's London, 1952.

This is a combined effort aimed to deal with both the wind produced waves and the tidal motions which are due to the earth's rotation and the reactions of the moon and sun on the oceans. It is definitely intended for mariners, naval architects and maritime engineers, but will also be of interest to geographers and the general reader. The authors are respectively attached to the Department of Scientific and Industrial Research and the Southampton Harbour Board, to which Commander Macmillan is the Hydrographic Surveyor. He is well known to our readers in connection with his articles on Marine Surveying and Echo Sounding.

There is not much mathematics in the book, which has practical aims, but sufficient is given to make the volume of real value.

Mr. Russell deals firstly with wind waves. Characteristics of ocean waves, ideal waves, generation of waves by wind, waves near shore, reflection, diffraction, refraction and wave-induced currents, movement of material by the sea, the effect of wave action on structures and wave measurement are the subjects of various chapters. Some simple formulae are then given.

Commander MacMillan then discusses tidal problems. The pulse of the earth, the equilibrium theory, modern tidal theory, tides and the navigator, tides and the local observer, tides and the weather, tidal streams, tides and the surveyor, tidal factors in history, commerce and sea power, a tidal miscellany (including bores), utilization of tidal energy and the future of tidal research. He concludes with a short mathematical appendix.

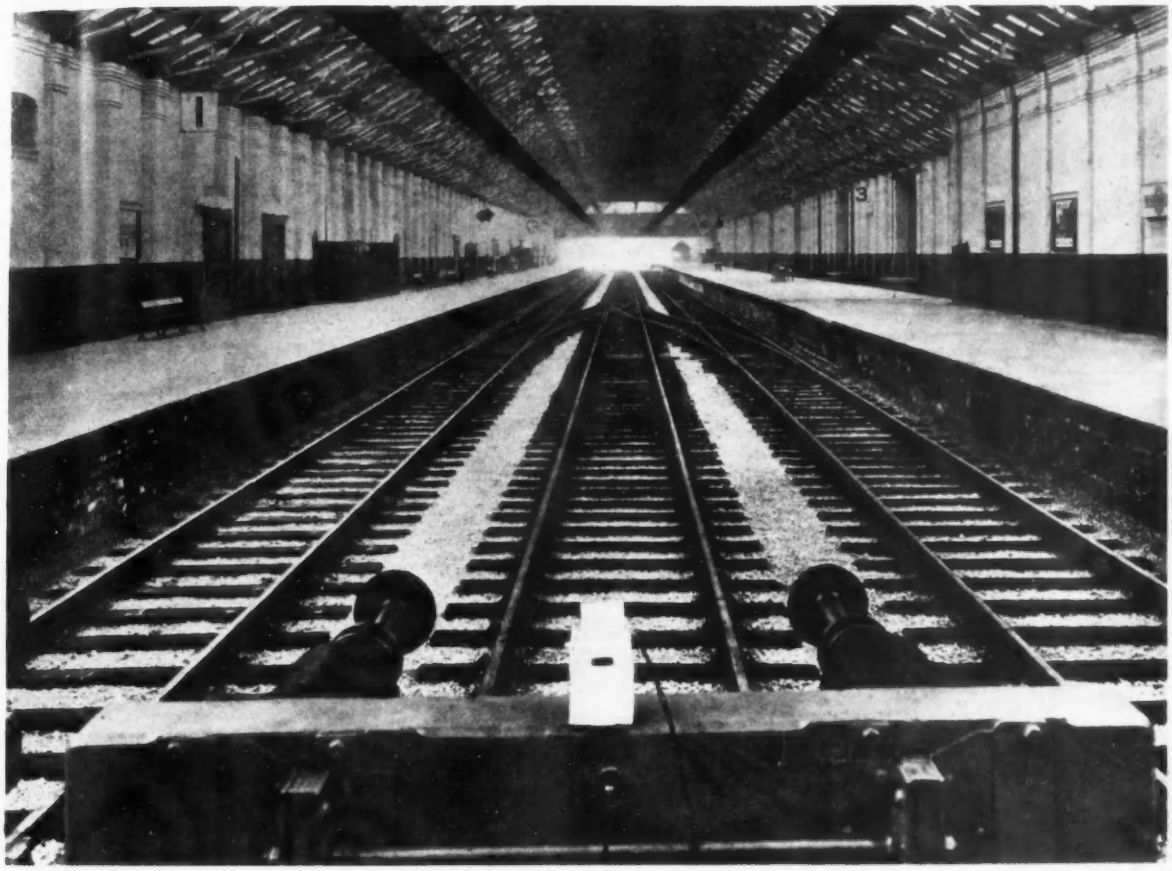
The photographs are excellent, the numerous diagrams are clear, and the modern tidal theory of Proudman and Doodson is well explained.

Mr. Russell includes essential matters investigated by Sverdrup and other students of the subject and considers in sufficient detail the work of Bagnold on wave forces and movement of bed material.

On p. 307 there is a small error. Instead of " disregarding bed friction " it should read " disregarding variations in bed friction."

W. H. Wheeler's book on " The Sea Coast " might well have been mentioned, as well as Mr. Minikin's articles on beach erosion. Something might have been said about the studies being made of beach erosion for the Government. This seems the more necessary as quite a good deal of publicity is given to the U.S.A. Beach Erosion Board. It might have been interesting to insert a brief note on wave motors although there seems no prospect that they can be usefully developed.

This may well rank as a first-class book, which should serve many who want a fair mixture of sound science without a superfluity of mathematics.



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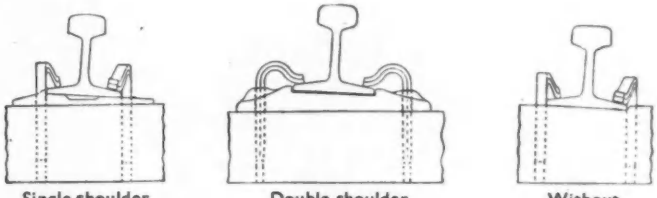

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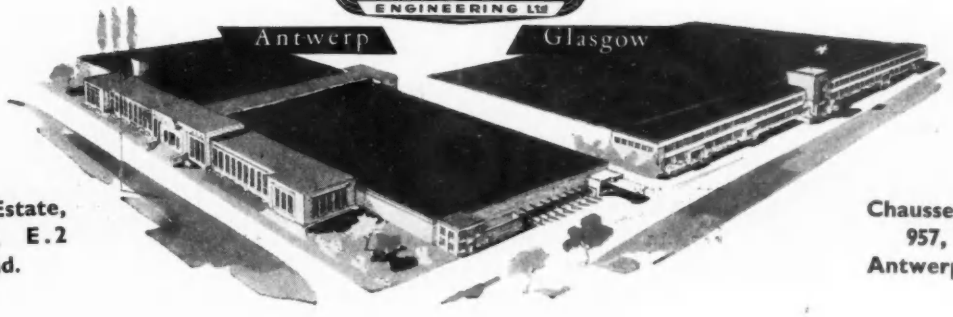

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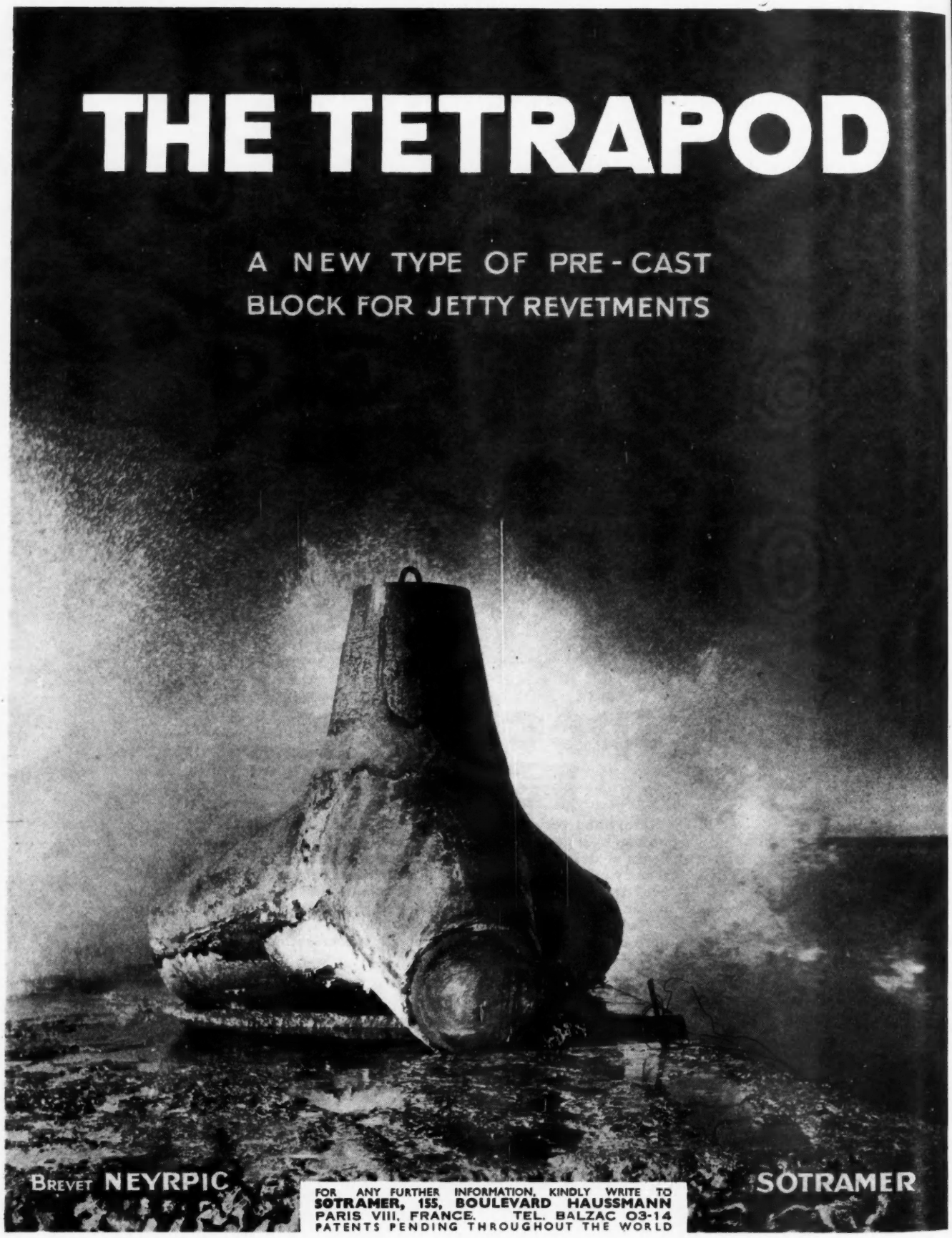
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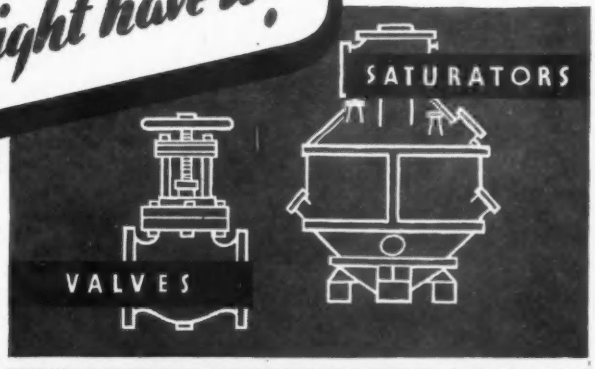

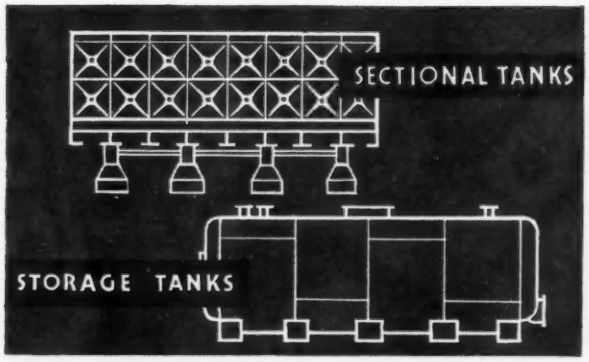

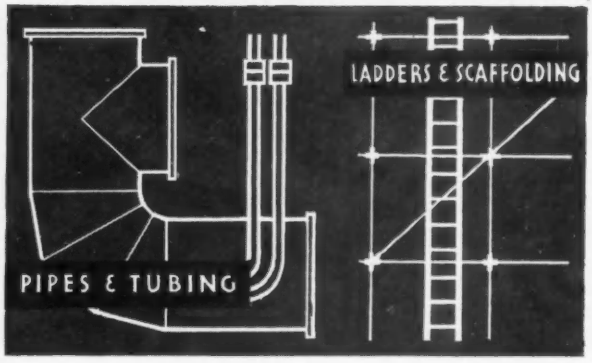

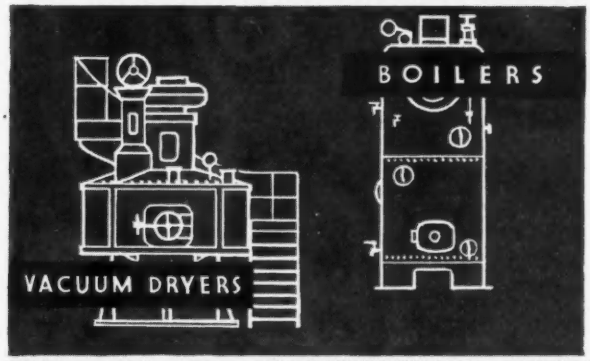

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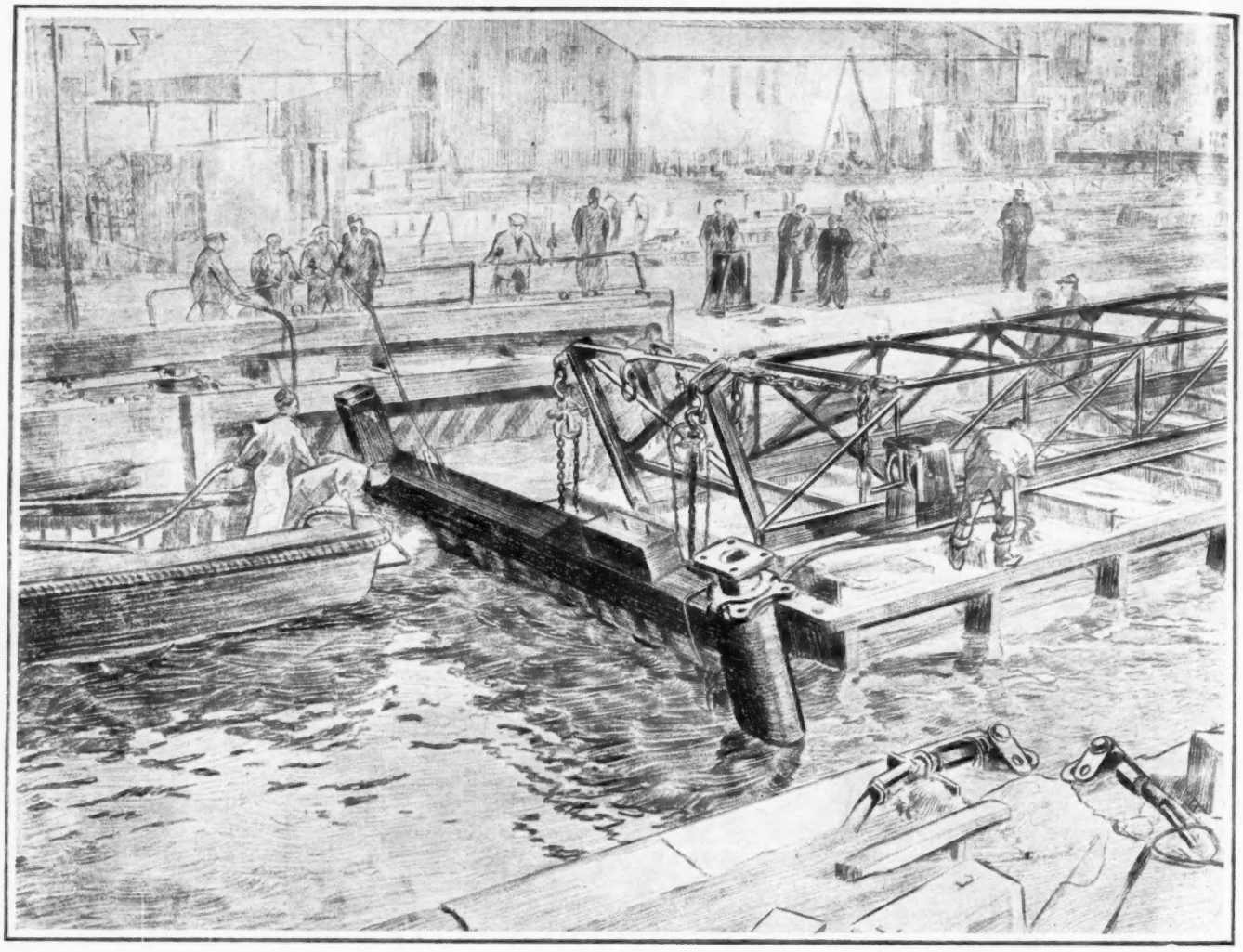

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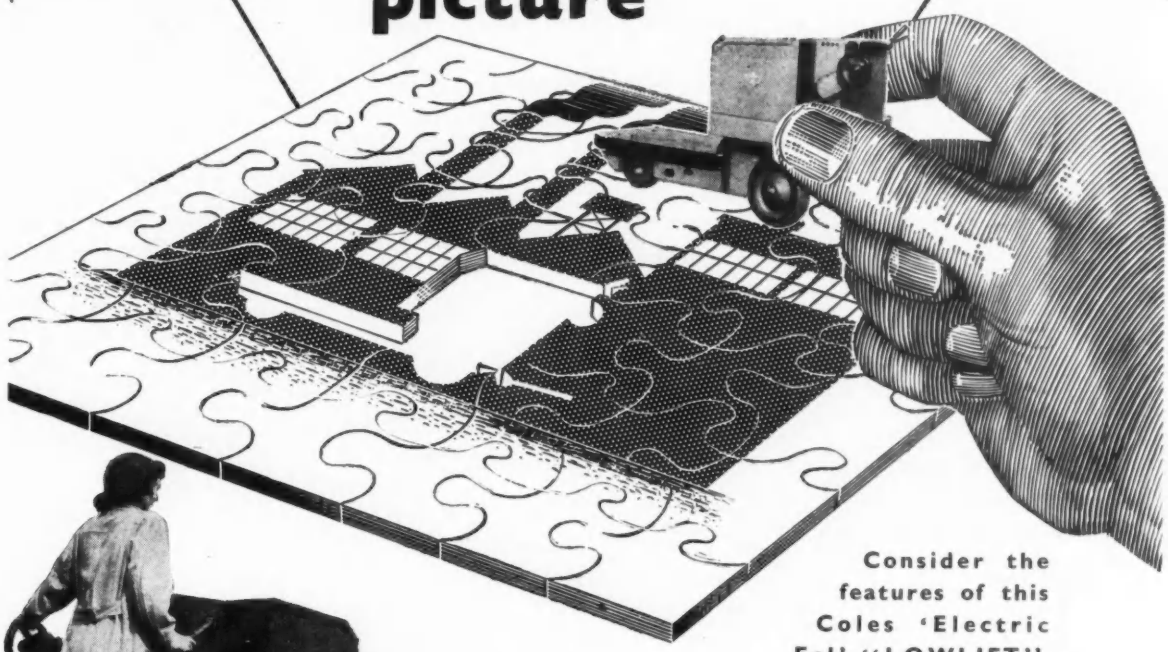

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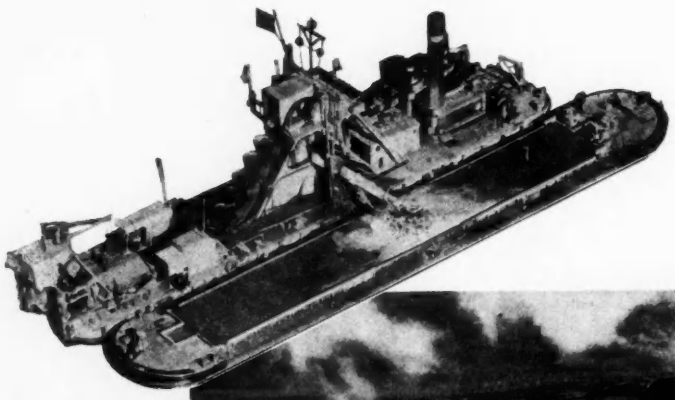

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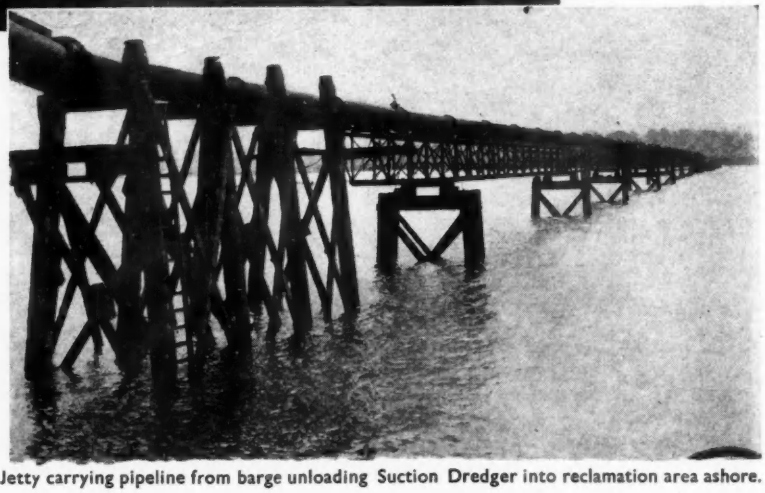

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Harbour Surging*

By VITO A. VANONI and JOHN H. CARR
California Institute of Technology, Pasadena, California.

Significance of Surging on Harbour Usage

Surge is the name applied to wave motion with period intermediate between that of ordinary wind waves and that of the tides; say from one to sixty minutes. An additional characteristic of surge is that it is usually of very low height; perhaps 0.3-ft. is typical. This type of wave motion has been observed along the entire Pacific coast of the United States (Coast and Geodetic Survey, 1943), and in some places, notably Los Angeles Harbour, has been of serious concern to harbour authorities (Calif. Inst. of Tech., 1945).

Although the height of surge may be so small that, coupled with the very great wave length, the motion cannot be visually observed as a wave train, the horizontal water motion may be large, and it is this factor which accounts for the importance of surge in harbour operations. Since the height of the surge wave is very small compared to either the wave length or water depth, the classical Airy wave theory (Beach Erosion Board, 1942) may be applied to the problem with small error. Thus, the horizontal amplitude of water motion is substantially constant from surface to bottom, and is equal to $\frac{HT}{2\pi}\sqrt{\frac{g}{d}}$ where H is the wave height (vertical distance from crest to trough), T is the wave period, d the water depth, and g the acceleration of gravity. The average water particle velocity is therefore $\frac{H}{\pi}\sqrt{\frac{g}{d}}$

This result may be easily verified in the case of a standing wave by reference to a diagram such as Fig. 1. If at some initial time the wave profile is in one extreme position as shown by the solid line, then a quarter wave period later the entire surface is horizontal, the water above the mean level in each crest flowing to the right and to the left to fill in half of each adjoining trough, and another quarter period later the surface is in the other extreme, as shown by the dashed line. Therefore, in one-half a wave period, a volume of water proportional to the area shown cross-hatched flows through each nodal section of depth d. The average flow rate, Q, is therefore:

$$Q = \frac{H\sqrt{gd}}{\pi}$$

and the average velocity through the nodal section becomes:

$$V = \frac{Q}{A} = \frac{H\sqrt{gd}}{\pi d} = \frac{H}{\pi}\sqrt{\frac{g}{d}}$$

As a numerical example, a 3-minute period surge, 0.3-ft. in height, would cause oscillatory horizontal water displacements of 9-ft. in a harbour depth of 30-ft., with an average velocity of 0.1-ft. per sec. or 0.06 knot.

Since a ship is small compared to the wave length of a surge (5,600-ft. in the foregoing example) it may be expected to move in space with the water motion unless rigidly restrained. Serious damage has occurred where such surge-excited ship motion has been resisted by dock and pier structures.

Characteristics of Long Period Waves

Wave Behaviour. Like other surface waves, long period waves may be of either progressive or standing type. Because of their large wave length, standing surge waves account for special problems and effects in harbours. A standing wave results from the superposition of two identical progressive wave trains travelling in opposite directions. Where the water particle motions due to each of the wave trains coincide, they mutually reinforce and the motion is doubled; conversely, where the motions are opposed the resultant is zero. The result is that at fixed positions a half-wave length apart the vertical amplitude of the water motion is a maximum, and half way between these antinodal points the vertical motion is zero. In a progressive wave train, the horizontal velocity of partial motion is greatest at points beneath the moving troughs and crests, but in a standing wave the horizontal velocity is zero at antinodes and a maximum at the position of no vertical motion or nodal points.

The important distinction between the two wave types as far as harbour surge is concerned is, therefore, that if the surge is due to a progressive wave train, all areas in the harbour experience the same maximum horizontal motion, whereas if the surge is of the standing wave type, there will be distinct areas of active and quiet water.

It is apparent that a standing wave always exists to seaward of a reflecting barrier, the reflected and incident waves combining to produce this result. In this connection, it should be noted that the reflective properties of a shoreline are determined by the scale of the irregularities of the shoreline with respect to the length of the waves. Thus, a given stretch of irregular shoreline will appear " straight " to long period waves, and the incident wave energy will be concentrated in a well-defined reflection, whereas the same shoreline will scatter reflected short period waves in all directions with resulting diffusion of energy.

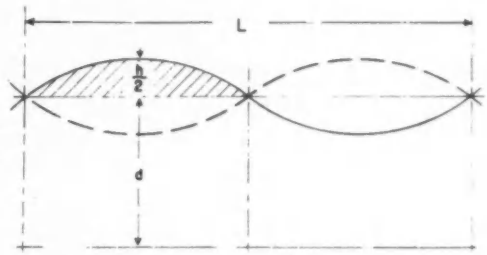


Fig. 1. Diagram for water motion in a standing wave.

If two parallel reflecting shorelines are oppositely disposed in a basin, a wave train will travel between them, each wave being successively reflected from one to the other, until damped out by frictional forces. If the distance between the reflecting shorelines is such that the time required for a wave to travel from one boundary to the other is an integer multiple of half the wave period, the standing wave patterns produced by reflection from each boundary will coincide, and a condition of free oscillation of the basin will result. In the case of a basin open at one end to the sea or other large body of water, and closed by a reflecting boundary at the other, it can be shown that the condition for free oscillation will be realised if the length of the basin is such that the wave travel time is an odd-integer multiple of one-quarter of the wave period (Sverdrup, Johnson and Fleming, 1942). It may be noted that the term seiche is applied to such free basin oscillation.

Basin oscillation, or seiching, is analogous to the motion of a spring-mass system, pendulum, or other mechanical or electrical oscillating system; once started, the motion persists unless brought to rest by outside forces. Fig. 2 illustrates the fundamental and first two harmonic modes of oscillation of basins.

In any type of oscillatory system, if a periodic excitation is applied at one of the free or natural periods of the system, the motion will increase to an amplitude determined by the damping of the system; this phenomena is termed resonance. Thus in the present case, if a long period wave train whose period corresponds to the fundamental or an harmonic period of the basin enters the harbour from the open sea, a condition of resonant basin oscillation will result. The significance of resonant basin oscillation is that all of the wave energy coming into the area is concentrated in one standing wave system, with resulting build-up of large amplitude vertical and horizontal water motion at the positions of nodes and antinodes. This amplification may result in a serious surge condition in a harbour basin even though the exciting long period wave train is nearly totally excluded from the harbour by a breakwater or mole. Thus, model studies of the Terminal Island Mole Basin (Calif. Inst. of Tech., 1945) have shown wave heights within the mole 50 per cent. greater than those in the outer harbour for critical surge periods.

*Excerpts from Paper presented at First Annual Conference of Coastal Engineering held at Long Beach, California, 1950. Reproduced by kind permission.

Harbour Surging—continued

Where the water depth in a basin is substantially constant, the velocity of shallow water, long period, waves may be taken as $\sqrt{gd}$, and the previously mentioned conditions for resonant periods become:

For closed basins:

$$T = \frac{2\,l}{(k+1)\sqrt{gd}}$$ where l is the basin length $k = 0, 1, 2, 3$, etc.

For open-ended basins:

$$T = \frac{4}{(2k+1)} \frac{l}{\sqrt{gd}}$$

Where the water depth is not uniform, the critical periods may be computed by numerical integration of the equations in the following form:

For closed basins:

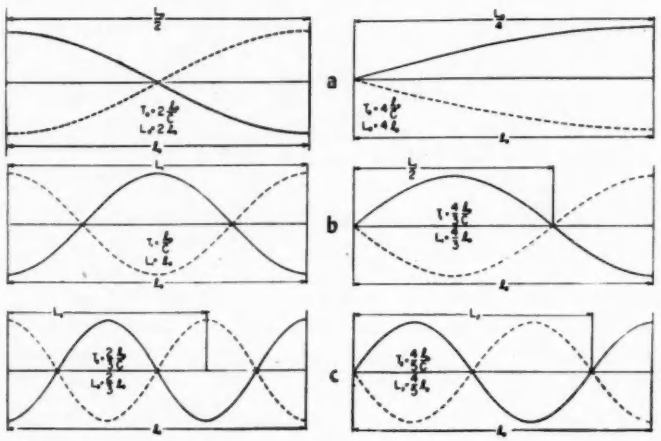
$$T = \frac{2}{k+1} \int_0^l \frac{dx}{\sqrt{gd_x}}$$

For open-ended basins:

$$T = \frac{4}{2k+1} \int_0^l \frac{dx}{\sqrt{gd_x}}$$

where d_x is the depth at distance x from the end of the basins.

These relations have been verified by model experiments for the cases of uniform water depth, and parabolic variation of water depth, at the University of California (Johnson, 1949). These experiments also investigated the damping effect of sills located at nodal points in the standing wave pattern, with the result that a sill of height approximately one-third the water depth was found to reduce the wave amplitude by approximately 50 per cent.



Closed Basin. Open-ended Basin.

Fig. 2. Modes of basin oscillation: (a) Fundamental; (b) First harmonic; (c) Second harmonic.

Sources of Long Period Disturbances. The question of the sources of the long period wave disturbances which cause surge problems in harbours is one which cannot be answered completely at the present time. Early thinking on this subject was confined to the assumption that surge was a phenomenon always related directly to the basin in which it occurred, hence it was a free oscillation of the basin following some initial disturbance such as a piling up of water due to winds, atmospheric pressure anomalies, or local seismic activity. This explanation is indeed the only one admissible for the case of seiching of completely land-locked basins such as lakes, but recent observations of surge activity in coastal regions have demonstrated the inadequacy of this theory as a general condition. The existence of surge conditions in harbours at intervals completely uncorrelated with local atmospheric or seismic disturbances has focused attention on the proposition that long period, low amplitude wave trains exist in the open sea, and where these wave trains enter a harbour they constitute a surge. If the wave period coincides with the natural period of the harbour basin, the waves will excite resonant oscillation, with resulting increase in the severity of the surge.

Remedial Measures

Since the princpal problem associated with harbour surging is unwanted ship motion, especially where ships are moored in close proximity to fixed structures such as docks or piers, alleviation of the problem will be obtained only by the reduction of ship motion to a tolerable minimum. Two approaches to this requirement are apparent; (1) the reduction in amplitude of the surge waves in the harbour, and (2) the development of mooring systems which will limit the amplitude of ship motion.

In connection with the first named approach, the reduction of breakwater gate width, or harbour opening, to the minimum required for navigational purposes will reduce the amount of long period wave energy which can enter the harbour from the sea, with resulting reduction in surge activity in the harbour. By way of illustration, model studies of the Navy Mole Basin at Terminal Island, California, indicated that a reduction in gate opening from 2,000 feet to 600 feet resulted in approximately 50 per cent. reduction in surge amplitude in the basin. The location of the harbour entrance is not so important in reducing entering surge excitation, since the entrance width is usually small compared to the wave length of the long period surge waves. As a result, the diffraction phenomena at the entrance are relatively independent of the direction of wave approach, and on the harbour side the transmitted wave energy is directed nearly uniformly in all directions.

The second approach to the solution of harbour surge problems, that of improvements in ship mooring practice, has received very little attention as yet. To be successful, a system must be developed that is virtually rigid, since if the ship moves at all, it acquires kinetic energy, and can then only be brought to rest by the conversion of this energy into strain energy of deflection of the mooring system.

It is also important that the elastic constants of the mooring system be proportioned to the mass of the ship so that the natural period of the ship-and-mooring system is not close to the expected period of harbour surge, since if these periods are nearly equal the ship will be driven at resonance by even small surge waves with resulting large amplitude ship motion and high stress in the mooring system. The effect of the elastic properties of the mooring system on ship motion and mooring stress has been analysed recently in great detail by Wilson (1950).

The Institute of Material Handling.

Since the end of the last war, there have been several attempts to form an Institute of Material Handling, but hitherto such efforts have not met with success. Last month, however, a meeting was held in London to consider plans formulated by a number of people representing both users and manufacturers of mechanical handling equipment, and the formation of such an Institute was agreed.

In his opening remarks, the chairman stressed that the meeting was called for by users and not manufacturers. He pointed out that many other Institutions or learned Societies touched on the subject, but did not specialise in Material Handling, and it was now felt that Material Handling should have a status of its own.

A general discussion then ensued, and it was finally decided that Membership of the Institute would be confined to individuals and not include firms or corporations, and that all persons engaged in Material Handling at all levels, provided they had the one interest in common in furthering the technique of Material Handling, would be eligible. A Provisional Council of 16 members, comprising four manufacturers and 12 users of equipment, was then elected.

Further information can be obtained from the Secretary, Mr. M. W. Paynter, A.C.C.S., 20/21, Took's Court, Cursitor Street, London, E.C.4.

Radar at the Port of Sunderland

Report on First Year's Successful Experiment

SINCE the Radar Station for shipping was opened experimentally at Sunderland in November, 1950, delays to ships because of fog in the vicinity of the port have been practically eliminated. Vessels are met promptly by pilots, irrespective of the visibility, and, tide conditions permitting, are brought right into the harbour.

The object of the experiment was to discover whether a standard marine radar, with a simple radio telephone system for communication between ships' pilots and the shore, could be used to assist the movement of ships in and out of small harbours. The installation is entirely operated by the pilots of the Sunderland Pilotage Authority.

As a result of the experiment two facts of importance have been established. One is that a relatively simple installation, at a cost within the reach of the smallest harbour authority, may be quite adequate for a small harbour. The second is that the radar used at Sunderland had been highly successful in its primary function of saving ships' time.

Factors at Sunderland.

It appeared to the Ministry of Transport that at small general ports a standard marine radar set might be fully adequate as a shore radar. Accordingly, in this connection the Port of Sunderland was visited, and as a result of discussions there with various shipping authorities, and after an examination of considerations such as the amount of shipping, incidence of fog, etc., it was decided that this was a suitable port for the purpose of the experiment.

Both north and south of the port there are rocky ledges off shore, and the outer harbour is bounded by two distinctive piers. Once through the entrance to the inner harbour, ships usually proceed either to the adjacent docks, or to the berths and coaling staithes about a mile up the River Wear. (See attached map.)

According to statistics supplied by the River Wear Commissioners, who operate the port, a total of 2,163 vessels, totalling 2,260,244 net registered tons, cleared Sunderland in 1947. Of these, 1,938 were coastwise and 225 foreign going. 1,503 arrived light and loaded coal; the remainder brought iron ore or other cargoes, arrived for repairs or in refuge, or were new buildings. There is no regular passenger traffic between Sunderland and other ports.

Figures of visibility conditions are kept at the Roker coastguard lookout, and monthly totals are given in the following table. It will be seen that visibility is less than a mile for about 11% of each year. At times the fog is dense, and may persist for two or three days on end.

Fog signals are sounded from the light tower at the end of Roker Pier, and from the end of the (old) North Pier. There is also a foghorn at Souter Point, a few miles to the north.

The English Decca Navigator chain provides fair coverage off Sunderland for coastal navigation and the coverage has recently been improved by the opening of the North British chain. This system is not recommended, however, for pilotage into harbours.

There are 19 pilots at Sunderland, based on the Pilot Watch House at the entrance to the Inner Harbour. A cutter and two launches are maintained by them. On the approach of a ship, a pilot boards the cutter, which is moored to the inner end of the pier, and is taken out to the ship well before she reaches the harbour. The cutter is also used to take pilots off outgoing ships.

Pilotage is not compulsory, but all foreign-going vessels of any size, and nearly all coastwise vessels, take pilots.

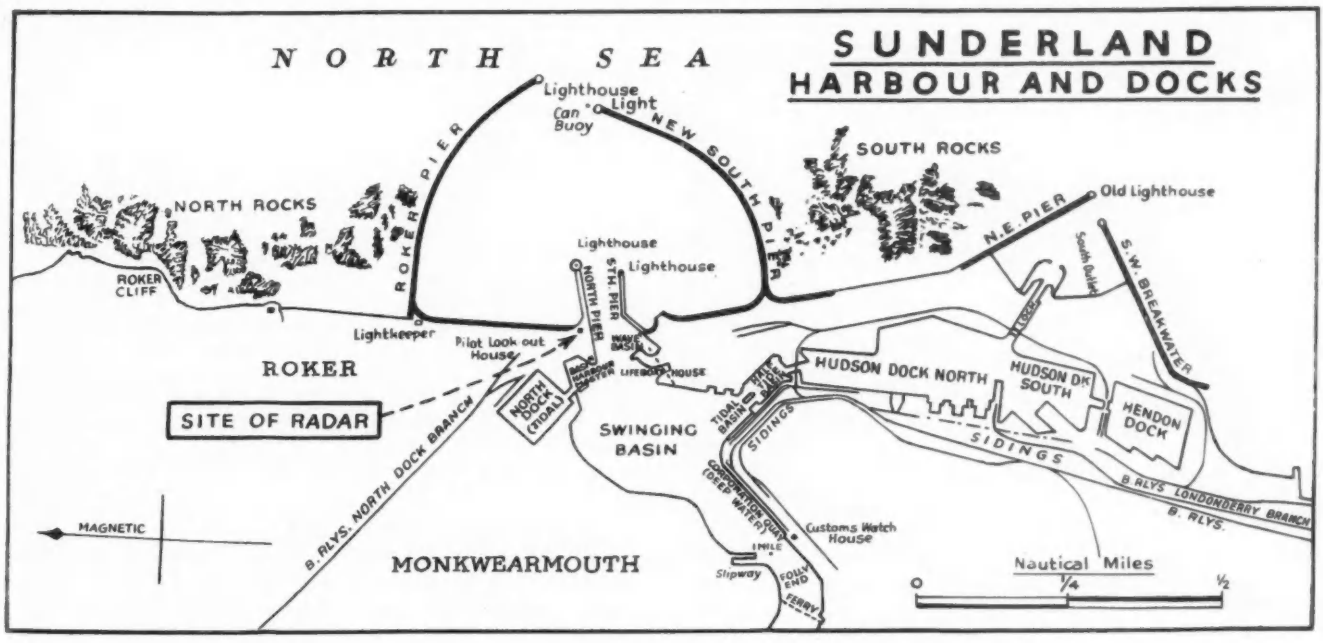
Half-a-mile to the north of the pilot house is a Coastguard Lookout where permanent watch is kept. The Lifeboat and slipway are near the exit from the Inner Harbour.

Delays and Shipping Casualties.

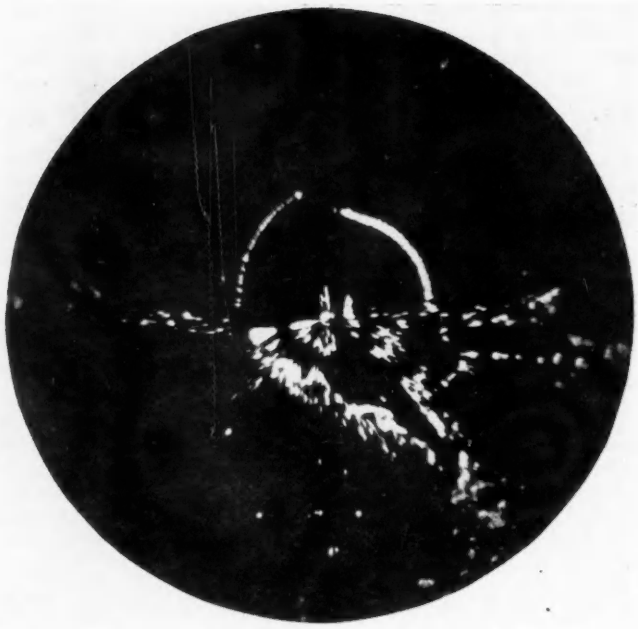
Previous to the introduction of radar, the pilots said that their greatest difficulty in fog was the location of vessels. Delays were most likely to occur then, rather than in the actual navigation into harbour. Once in the river, delays were not of account save in the very worst of fogs.

They estimated that radar would be of positive assistance in helping them to find ships, and thus avoiding delays, on the average about once a week.

At the request of the Ministry, the pilots agreed to keep a record of ships delayed by fog entering Sunderland from June, 1948, onwards. This, as a log of delays, proved disappointing; only about half-a-dozen entries were made in the year following, five of a few hours each to incoming vessels, and one of nine hours to an outgoing vessel. It is thought that these examples are only an incomplete record of the delays that actually occurred, for unless the subject was raised between the ship's master and the



Radar at the Port of Sunderland—continued



Sunderland harbour and piers as seen on the radar screen.

pilot, the pilot could not be sure how long a ship had been waiting.

An examination of the Ministry's casualty records showed that in the 12 years up to 1947, there were about 20 shipping casualties in conditions of reduced visibility within two-and-a-half miles of the harbour entrance. About half of these casualties were strandings immediately to the northward on Roker Beach and Whitburn Steel. Allowance must, of course, be made for the wartime conditions during half this period. Even so, the pilots stated it was not uncommon for ships from the south to over-run the port and turn in between Sunderland and Souter Point.

The Radar and Radio Installations.

The specification for the whole installation, to embody a typical modern shipborne type of radar, was drawn up by the Admiralty Signal and Radar Establishment, acting on behalf of the Ministry of Transport. Messrs. Kelvin & Hughes Ltd. offered to supply and instal the apparatus on loan for an experimental period of one year, and to maintain it free of charge during that period. At the end of this period the equipment was to be offered to the River Wear Commissioners for purchase.

Table Showing Incidence of Thick Weather at Sunderland.

Hours per month during which visibility was less than 1 mile from Coastguard Lookout.

	1947	1948	1949	1950	1951	Average
January ...	66	31	97	213	291	140
February ...	30	42	116	135	114	87
March ...	160	159	79	140	145	137
April ...	12	17	5	35	23	18
May ...	34	37	31	94	82	56
June ...	79	16	23	4	44	33
July ...	45	32	20	17	1	23
August ...	178	13	37	35	41	61
September ...	35	9	90	0	77	42
October ...	74	50	150	31	158	93
November ...	103	264	139	169	36	142
December ...	120	113	60	242	140	135
Yearly Total ...	936	783	847	1115	1152	967
Yearly % ...	10.7	8.9	9.7	12.7	13.2	11.0

Total thick weather 1st November, 1950—31st October, 1951=1387 hours. (15.8%).
Number of occasions of Thick Weather=139.
Number of occasions on which visibility fell to ¼ mile or less=76.
Average duration=10 hrs.
Longest continuous duration=77 hrs.

The equipment is installed in the Pilots' Watch House. The main display unit is sited in the lookout room on the first floor of the building, in a position in which the view to seaward may be directly compared with the P.P.I. picture. On the ground floor of the building a room has been set aside for the transmitter, receiver, motor generator and associated control gear, and a second display unit. The purpose of the second unit was to be available for experiments conducted by Admiralty Signal and Radar Establishment in connection with the identification of ships. The radar aerial, of simple cheese type, is mounted at the top of a steel lattice tower, and is reached by a ladder to a platform which facilitates servicing. The echo box for monitoring the performance of the set is attached to the rail round this platform some 8-ft. from the aerial.

The V.H.F. radio telephone equipment was supplied by The Automatic Telephone & Electric Co., Ltd., acting in conjunction with British Telecommunications Research, Ltd., their associated company, the terms being the same as for the radar, that is, on loan for a year.

A mains-operated V.H.F. transmitter-receiver is installed in the Pilot Watch House, adjacent to the lookout room. The system employs amplitude modulated two frequency simplex for pilotage transmissions. A second and similar set operates on single frequency simplex, on the International Guard Frequency in the V.H.F. harbour radio band. Two G.P.O. type handsets are mounted conveniently to the main display unit for operating these transmitter-receivers. Miniature loudspeakers are automatically switched in when the receivers are at stand-by.

The V.H.F. aerials are coaxial dipoles, mounted on outriggers fixed to the top of the steel tower.

A 12-volt battery-operated transmitter-receiver is permanently fitted in the pilot cutter, the batteries being charged by a generator on the main engine. Loud hailer facilities are also available on this cutter.

Four portable transmitter-receivers for the use of the pilots are normally kept available in the wheelhouse of the cutter ready for use. Each is carried in a padded waterproof canvas case with handles.

The Radar Display.

On the one-mile scale, the largest, a very good picture is obtained, characterised mainly by the two curved piers, one to the north and the other to the south of the harbour entrance. Close to the pilot house, the narrow inner entrance (100 yards between piers) is distinctly shown, while up river the view extends to the first bend without obstruction, the Swinging Basin, South Dock entrance, North Dock and the Deep Water Quay being easily recognisable. The bridge over the Wear at Sunderland is shown as an isolated echo near the edge of the display.

To sea, the echo of a small can buoy near the end of the South Pier is noticeable. Southwards, the old lighthouse gives an echo which may be used for aligning the display, and to the north Roker Cliff may be seen, together with the North Rock, whose appearance varies with the state of the tide.

The performance monitor echo is exhibited strongly on this scale, but is on a bearing which does not affect in any way the use of the radar.

The five-mile range encloses most of the echoes which are normally visible, as high land and buildings in the vicinity obscure distant echoes. The most northerly echo visible on the coast is Cape Carr Point, which conceals the land behind it, including Souter Point and the Tyne entrance. Inland, an echo is received from the vicinity of Whitburn Colliery at three miles.

To sea, echoes are received from the Hendon Rock Buoy, at about one-and-a-half miles, and the Ballast Buoy at two miles.

The nine-mile range brings in Seaham Harbour at five miles and Hawthorn Point, or a nearby echo, at six-and-a-half miles. Echoes in excess of these ranges are only observed in what are believed to be super-refraction conditions.

The display is not, as in some shore radars, off-centred in any way.

The presence of sea clutter has proved to be no problem in the detection and observation of ships and boats at useful ranges. At less than half-a-mile, where the clutter would normally be worst, the water is within the protection afforded by the piers, and small echoes may be singled out in bad weather by the use of the anti-clutter control.

Radar at the Port of Sunderland—continued

In rough seas it has been noticed that the echoes from the buoys out to sea are obscured by clutter.

At certain states of the tide and weather conditions, interesting effects may be observed on the radar screen. For example, the demarcation line of the ebb from the Wear meeting the north-going tide outside the harbour entrance has been seen as a distinct curved line in the sea clutter.

One reference in the log is to a vessel unobserved until she was a quarter-mile east of the harbour, due to radar interference. Questioned about this, one pilot said that a vessel fitted with a similar make of radar, and in the vicinity of the pilot house, created so much interference as to make the radar unusable.

This problem of interference is of course common to other shipborne and shorebased radars, and is kept under review by the Ministry of Transport. It is probable that on the occasions referred to, one of the longer range scales was in use; experiments have shown that on the short range scales, with a fast rate of sweep on the time base, interference is reduced to almost unnoticeable proportions.

Guidance of Shipping in Reduced Visibility.

If visibility is low, and a ship is expected at a particular time, the radar is switched on beforehand by the pilots and watch is kept by them. The nine-mile range scale is considered fully adequate for this purpose. In most, though not all, cases the echo is correctly identified from a knowledge of the E.T.A. of an expected ship, as soon as it appears that she has turned in towards Sunderland.

The pilot due to take the vessel then boards the launch or cutter. Another pilot standing by the radar in the watch house then directs the boat to a point some one-and-a-half to two miles from the harbour entrance where the ship can be intercepted. The pilot operating the radar set is usually the one next on the rota; or, if several pilots happen to be present, one of those not immediately due for duty may take over. Either before boarding, or just after if visibility is low enough to make it worthwhile taking a portable set on to the ship, the pilot is given his range and bearing from Roker Lighthouse, together with any other information likely to be of use to him, such as the positions and movements of other ships he may meet. In fog, when the pilot will, of course, take a portable set on to the ship, he is then given a course to steer which will bring him to a point about half-a-mile east of the lighthouse, to an " open-harbour " position. The ship's movements are followed on the radar screen and her position given to the pilot at intervals, together with any suggested alterations or amendments to his course.

From the " open-harbour " position into the harbour the ship is turned on to a course which is nominally 255° magnetic. Any corrections to this course made necessary by the prevailing wind and tide conditions are either made by the pilot or he may receive directions such as " port half a point " from the pilot at the radar station. The ship is brought along in this manner until her pilot is able to sight the lighthouse himself.

Plotting of ships is only rarely carried out, all bearings and ranges being given directly from measurements made with the cursor and variable marker on the set. When used for bringing ships in, the variable short range is set to about two-and-a-half miles.

Once the pilot on the ship has sighted the lighthouse, it is only when fog is exceptionally thick that he would require further guidance, though his course may be watched on the P.P.I. as a precaution.

It may be noted here that after a ship has berthed, the portable radio set is usually left at a nearby shore office, to be collected later by a pilot launch at a convenient opportunity.

Liaison with Life-Saving Authorities.

The Coastguard station being situated only half-a-mile to the north of the Pilot House, the area of view from it is little different from that at the latter except that it has an advantage in height. Should the Coastguard require information on the range and bearing of an object at sea, that he cannot obtain directly, this is quickly given by the pilots from the radar upon receipt of a telephone call. Conversely, should the pilots be using the radar and see a ship standing into danger, they inform the Coastguard by telephone so that maroons or rockets may be fired to warn the ship off, and if necessary the lifeboat may be called out.

Saving of Ships' Time.

That the radar has been highly successful cannot be doubted by anyone who has had an opportunity to talk to the pilots. Vessels are met promptly irrespective of the visibility, and, tide conditions permitting, are brought right into the harbour. The Harbourmaster confirms that since the radar was installed, delays to ships through foggy conditions have been practically non-existent.

A typical entry in the log, in a case in which time was saved, is as follows :

" 24/5/51, 1800 G.M.T. Visibility one-and-a-half miles. Object observed seven miles, proved to be s.s. " _____ " loaded with iron ore, with a draft of 24-ft. Boarded 2100 hours, R/T taken on board, with only 3-ft. 6-in. to spare at No. 1 Gateway. With the assistance of observation through radar and R/T this ship definitely saved lock in to South Dock."

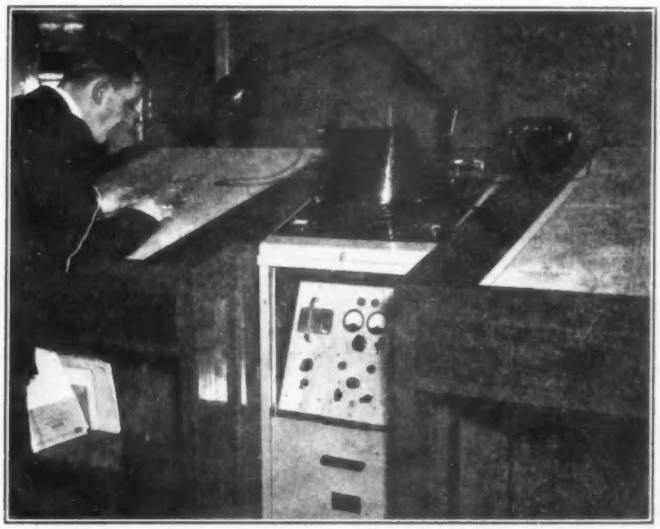
The significance of this is that had the dockmaster not been appraised of the arrival of the ship while she was still some miles out to sea, the lock gates would have been closed earlier on the falling tide and she would have had to wait for the next tide. Six log entries refer to a tide being saved in this manner.

Most of the cases in which time has evidently been saved refer to visibility conditions of less than one mile. In these cases the pilot boat has been enabled to go straight out to the vessel and bring her in, avoiding the delays occasioned either by the ship having to anchor and sound her siren for the pilot, or by the time taken by the pilot boat to locate the ship, or by the possibility of the fog then preventing the ship from being brought in.

How much time has been saved to ships is impossible to estimate from the incomplete record available. In the log, however, there are 66 specific individual instances in which it is evident that the radar has been of positive assistance in bringing a ship in and probably saving time, the ship being met beyond visibility range.

One finding of interest is that the radar is used in other conditions than fog, for example, on dark nights, or to pick up ships before they or their lights are seen even in fair visibility. This is proved by the 3,170 hours use of the radar in the 12 months, in which visibility was less than a mile for 1,387 hours.

Only one instance is known in which radar was unable to assist a ship taking a pilot. This vessel, of 9,000 tons, and herself fitted with radar, arrived in dense fog and anchored off. Preparations were made for her reception, but the pilot considered it inadvisable to take the risk of bringing such a comparatively large ship through



The radar set is placed between two charts mounted on sloping desks for easy reference. (A visor is placed over the radar picture to exclude light.)

Radar at the Port of Sunderland—continued

the narrow inner harbour entrance and docking her in the prevailing conditions.

No investigation has been made of the saving of expenses on shore, but from inquiries at other ports affected by fog, it would appear that the benefit to Sunderland of being able to make arrangements for reception of ships, discharging, etc., must have been considerable.

Outgoing ships do not often require assistance from the shore radar unless the fog is exceptionally thick. But a statement as to the disposition of shipping on a vessel's course may be given her when she leaves the port, and this is most appreciated by ships without radar.

Prevention of Casualties to Shipping.

Several instances in which radar may well have averted a casualty occurred during the year. Details of the most important of these are as follows :

1. The day before the official opening of the station, and while the set was being checked over to ensure good performance on the next day, the echo of a vessel was observed to be close to the White Steel rocks to the north of the pilot house. The coastguard was immediately informed, and fired maroons to warn the ship, while the pilot cutter left to make for her. She was found to be a small tanker bound for Sunderland, and was brought safely in.

2. A very similar case occurred three months later, in the same area. On this occasion the vessel was a medium-sized passenger cargo vessel, and although herself fitted with radar was in a most dangerous position and steering a dangerous course. She was met and brought in to Sunderland, after being warned by maroons.

3. Other instances include the direction of the lifeboat to a fishing boat on fire, and later the location and salvage of this boat in the dark when the fire had died down; the direction of the lifeboat to a fishing vessel with an engine broken down; and the direction of the pilot cutter to a vessel described as " obviously lost."

The local Coastguards are fully aware of the assistance that radar can afford them, and much appreciate that when a vessel is standing in too close in fog, her position can be obtained immediately and exactly by putting through a telephone call to the pilots, thus doing away with reliance on the often misleading guesses as to the vessel's position from the sound of her siren.

Other Benefits.

Many shipping interests have taken advantage of the advance warning given by radar of the approach of shipping. These include the harbour authorities, shipowners and agents, tugboat operators and foyboatmen. Final arrangements for bringing in and berthing a ship can now be made with confidence when the ship is at perhaps same threequarters of an hour's steaming distance, whereas previously during thick weather the arrival of the ship could not be relied upon until she was actually in the river.

Delays at Other Ports.

Much of the trade at Sunderland is done with ships from London, and it has been noticed on several occasions that although Sunderland is now able to cope with any reasonable number of ships in fog, ships are held up either off the coast or in the Thames and its estuary. After one such hold up, it was noticed that seven colliers arrived shortly after one another. This state of affairs seemed to indicate that the Sunderland scheme will be even more effective when it is backed up by schemes at other ports.

Suitability of Equipment.

The radar equipment used has proved highly satisfactory for the main purpose of guiding ships. No adverse comment has been made regarding the size of display, brilliance, definition, controls, and so on.

For the purpose of pilotage, accuracy of the ship's position relative to other echoes on the screen, such as the piers, is of more importance than absolute accuracy. In pinpointing the absolute positions of buoys, however, the tolerances allowable by the Ministry of Transport Marine Radar Specification must be borne in mind; these are 1° in bearing accuracy, and 5% of the maximum range of the scale in use. Thus a buoy at two miles on the five-mile scale might be shown with a positional error of a quarter of a mile. This can be allowed for if the set is specially calibrated.

Experiments on Identification.

From time to time throughout the year, the radar station has been visited by representatives of the Admiralty Signal and Radar Establishment. Trials have been carried out upon the use of reflectors for increasing the detection ranges of the pilot craft. Trials were also carried out using two methods of identification:—

(i) using a 3 cm. radar responder beacon, and

(ii) using a Decca Navigator receiver.

The first system provides continuous identification on the radar screen while the second system consists of plotting the Decca co-ordinates of the ship to be identified on the radar screen, the information having been received over a V.H.F. voice link. Trials are continuing with both of these systems at the Admiralty Signal and Radar Establishment, Eastney, Portsmouth.

Conclusions.

There seems to be little doubt that the radar is thoroughly appreciated by the pilots. Through it they are saved having to go out in the launch, often in unpleasant conditions, to search or wait for a vessel which is expected, yet which may have been delayed unknown to them. By keeping watch on the screen for the approach of vessels, the duty pilot may call pilots from their homes directly if ships appear ahead of their E.T.A.

The radar is also appreciated by ships' officers ; Masters of vessels regularly visiting Sunderland are said to have full confidence in the system and to regard it as a definite asset to the business of the port.

As regards ships fitted with the Decca Navigator, the port radar serves a very useful purpose in backing up this aid to coastal navigation, in that the assistance rendered by Decca in keeping the ship to a time schedule is not lost on arrival by the ship having to wait for a pilot.

The conclusions which may be drawn at this stage are that the Ministry of Transport experiment to determine the possibility of utilising a standard marine radar together with a simple radio telephone system to assist the movement of ships into and out of small harbours has been successful.

The experiment has definitely shown that the pilots, once they have acquired an appreciation of the capabilities and limitations of the equipment, have no hesitation in putting it to the fullest use.

It has also shown that, in addition to undertaking the full operation of the system, the pilots are also capable of undertaking limited maintenance and the replacement of expendable items.

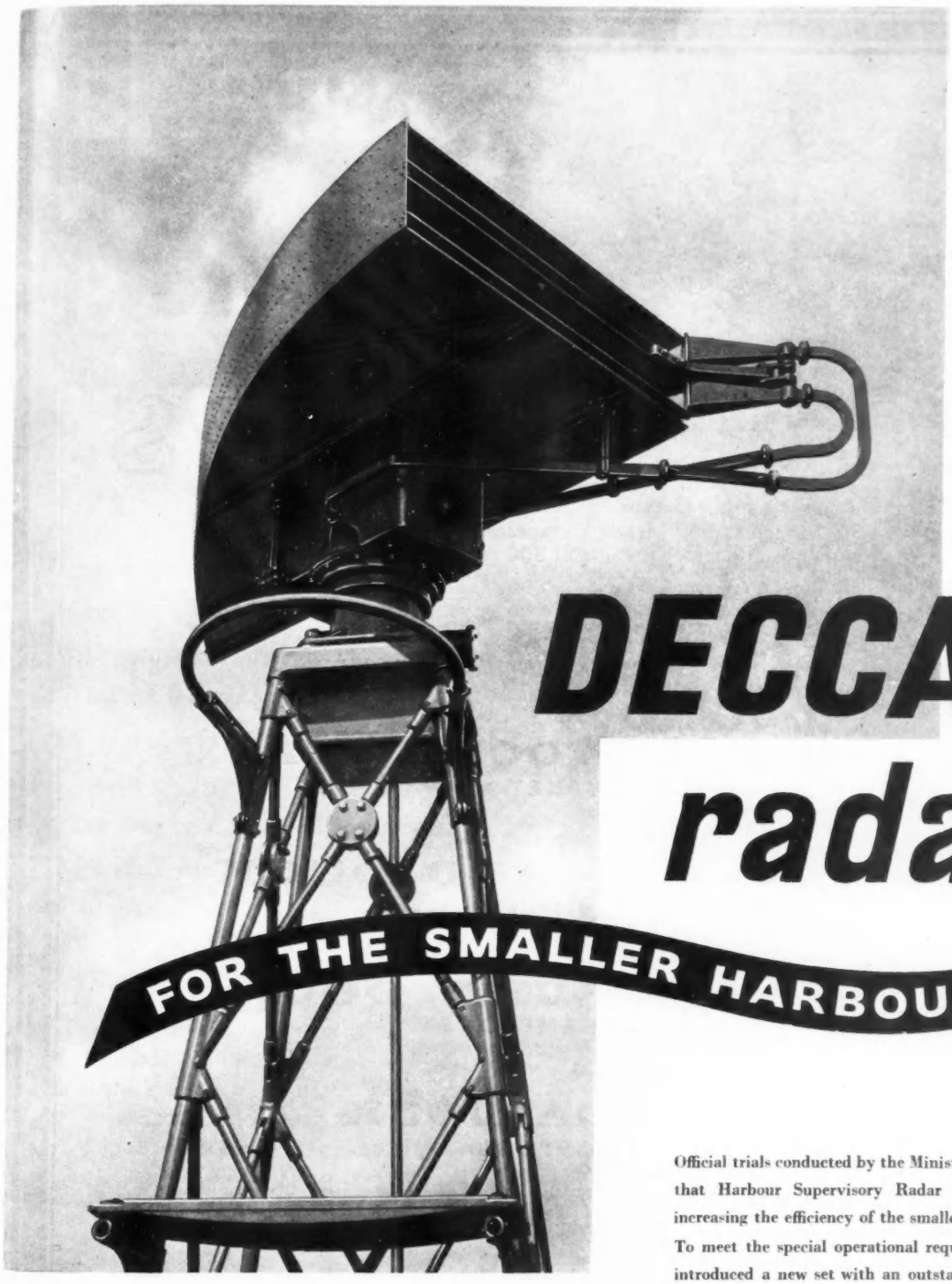
The River Wear Commissioners have now purchased the equipment at a cost of £5,250.

Obituary

Mr. Robert Davidson, C.B.E.

We regret to record the death of Mr. Robert Davidson, a full-time Member of the Docks and Inland Waterways Executive, since 1947, and an authority on the inland waterway systems of this country, who died on May 17 last, aged 64.

Mr. Davidson was a former General Manager and Engineer, subsequently a director, of the Leeds and Liverpool Canal Company. His other appointments included those of President of the Canal Association and Chairman of the North Western Region Canal Committee. He formed Canal Transport, Ltd., in 1930, becoming the Company's first Manager in 1936, and became Chairman of James Mayor & Co., Ltd., Engineers and Boat Builders. Throughout the last war he served as a Member of the Liverpool Port Emergency Committee, and was the first Chairman of the Inland Waterways Engineering Committee set up by the Ministry of War Transport. His long services to inland waterways were recognised in 1950 when he was appointed a C.B.E.



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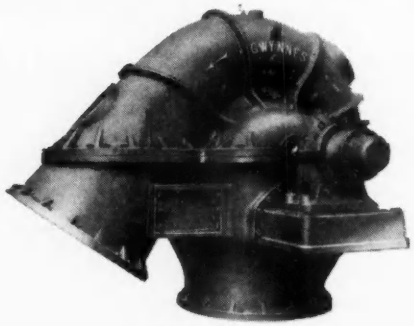

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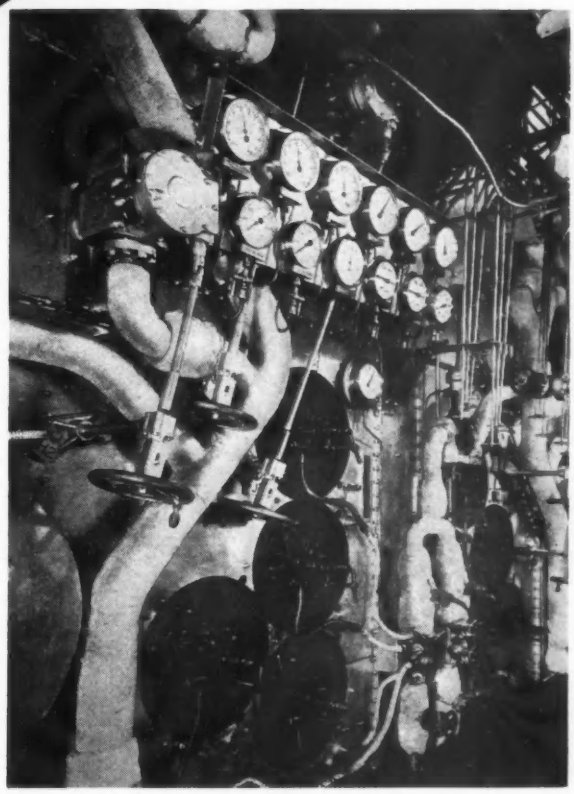

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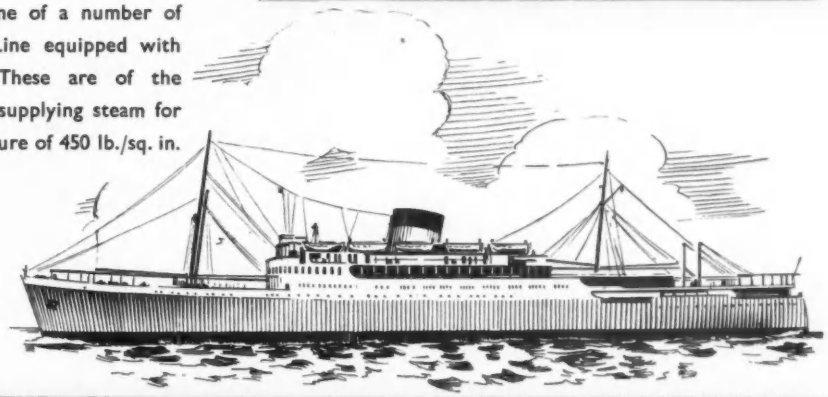

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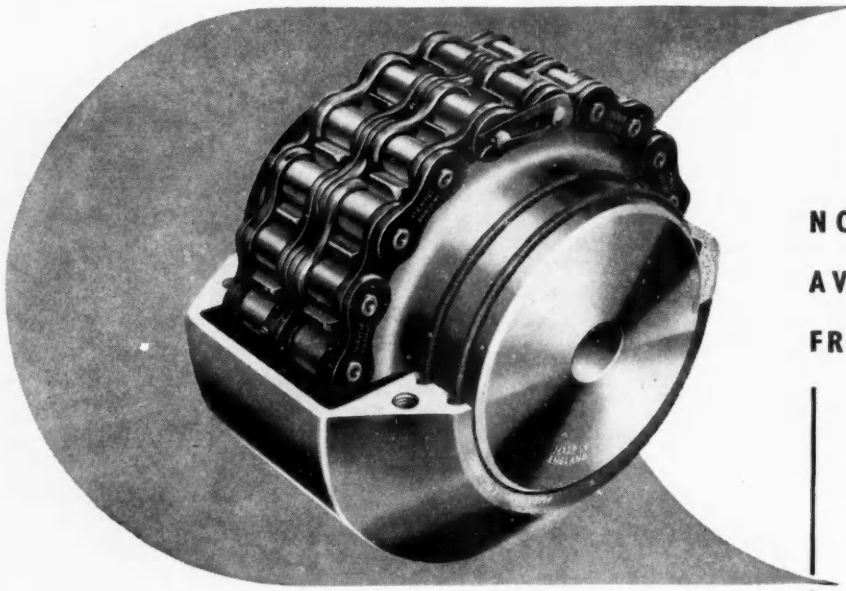

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·375″	·3	4,800	·6	4,800
·5″	·75	3,600	1·5	3,600
·75″	2·5	2,400	4·5	2,500
1·0″	6·0	1,800	9·0	1,900
1·25″	12·0	1,400	15·0	1,500
1·5″	20·0	1,200	30·0	1,250

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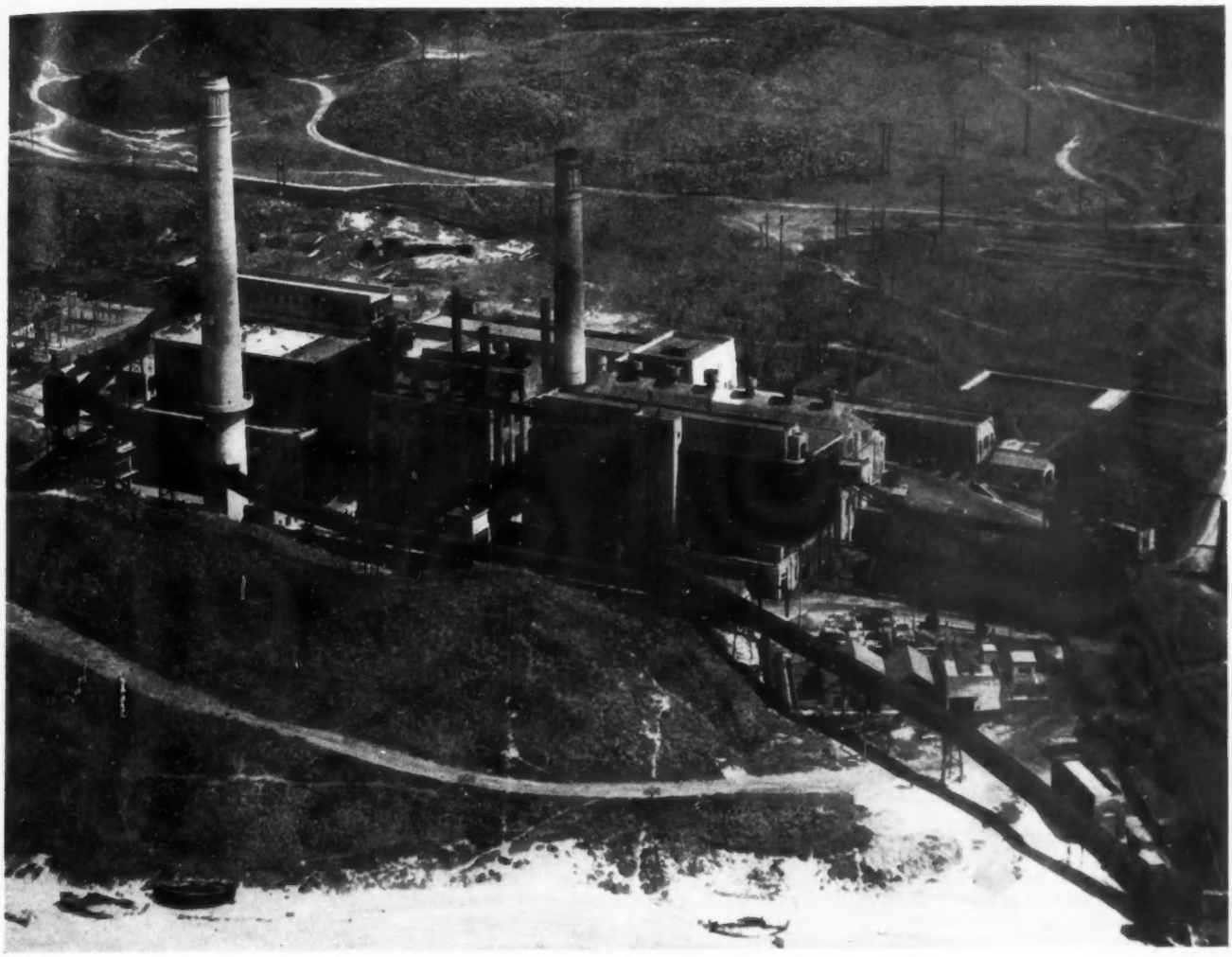

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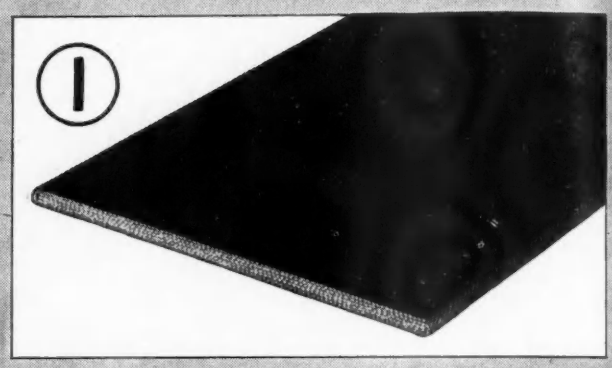

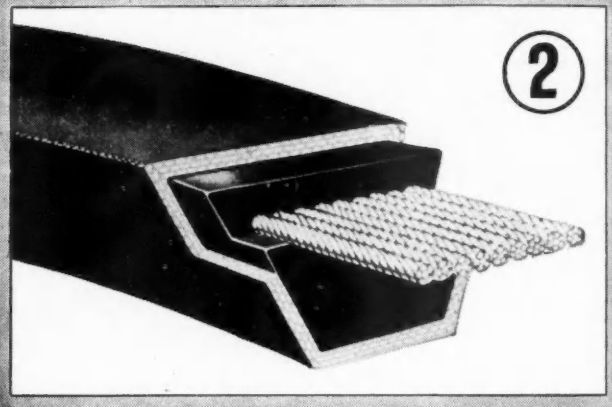

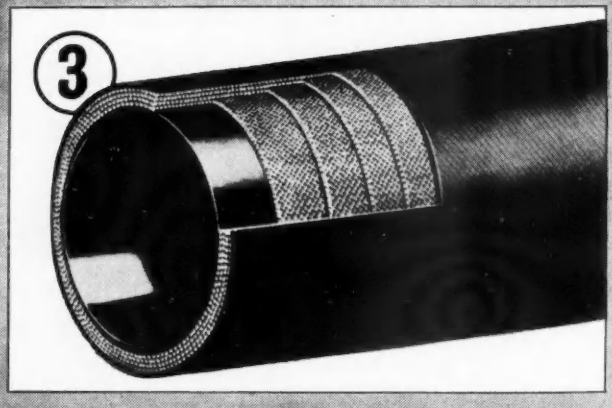

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Port Economics

Part 6. Port Labour

By A. H. J. Bown, O.B.E., F.C.I.S., M.Inst.T.
General Manager and Clerk, River Wear Commissioners, and General Manager, Sunderland Corporation Quay.

As was noted in the preceding chapter, some modern economists recognise three factors of production—labour, land and capital: and by labour they mean the use of minds as well as muscles. Other writers on this subject add a fourth factor which they call enterprise or organisation: and they hold that the reward of labour is wages; of land, rent; of capital, interest; and of enterprise, profit. The former school, in expanding the meaning of labour to include every kind of human effort devoted to the business of production, advances the notion that every person concerned must exercise some degree of judgment, mental agility or organising skill: therefore, the monetary reward, otherwise separately classified as profit, may be spread over and included as one of the various elements in wages and salaries, in rent and in interest on capital. For our present purpose, the difference between these two views is not especially significant, for there is no dispute that the function of labour is highly important and that its reward should always be commensurate with the value of its contribution.

The facilities and services made available and kept in supply at the world's seaports have called for—and continue to demand—a considerable effort from brains and from brawn. It is a mark of social progress that the main emphasis should tend to shift from the second to the first. An entirely mechanical job ought to be done by a machine. This is an ideal much in the minds of all concerned with ports and docks.

In the companion volume to the present series (Port Administration and Operation—Chapman and Hall), Chapter VII (pages 201 to 217) was entirely devoted to the history, analysis and problems of dock labour—more particularly in the United Kingdom. A large amount of detail is there provided and it is not proposed to repeat it here. It may be useful, however, to give an account of what has happened since the companion chapter was written: and to attempt some review of the economic aspects of port labour.

Recent Developments.

The former study took the matter as far as The Dock Workers (Regulation of Employment) Order, 1947. That Order set up the National Dock Labour Board as the permanent successor of the war-time National Dock Labour Corporation. At that time, the labour force of dock workers under the scheme amounted to about 78,500 men spread over the 83 principal ports of Great Britain. Their agreed minimum daily wage, payable on a half-daily basis, was 19s.: but the vast majority of the men were piece-workers (as they still are) normally earning much more than 19s. for a day's work. On and from the 12th February, 1951, the 19s. was increased to 21s. and piece rates were advanced by an agreed percentage. On and from the 25th February, 1952, the 21s. was increased to 22s. 6d. and piece rates were again advanced by an agreed percentage. It has recently been authoritatively stated that, towards the end of 1951, actual average earnings were rather more than £10 per week (everything included) and that the proportion of pieceworkers was about 85 per cent. of the labour force. The daily time rate of 22s. 6d. on the half-daily basis, also constitutes a minimum guarantee for pieceworkers. The regulating body concerned with wages and conditions of dock workers is the National Joint Council for the Port Transport Industry: and the National Dock Labour Board administers the Dock Workers (Regulation of Employment) Scheme.

The main purpose of the dock labour Scheme was to put an end to the waste, inefficiency and haphazard character of the casual labour system. Much has been achieved under the Scheme but more remains to be accomplished. Casual labour is dead: but casual mentality is only dying. This is not altogether unnatural; for the Scheme effected nothing less than a social revolution and time must always pass before a new order, however good, can be firmly established.

The Scheme exists to ensure greater regularity of employment for dock workers and to secure that an adequate number of dock workers is available for the efficient performance of dock work. Employers and workers must be registered: and the workers must report for work as required and observe industrial agreements. Their reward for carrying out these obligations is the status and security which attach to a regular position with a guaranteed weekly wage. The weekly guarantee is £4 8s.—irrespective of whether a man works or not: alongside this weekly guarantee (but not in addition to it), every registered worker is credited with 5s. in respect of every half-day when he reports for work and obtains none. There are eleven four-hour turns in his normal working week: and when he works a turn, he is paid, most often, on an agreed piecework basis with a guaranteed minimum fall-back of 11s. 3d. If he is one of the small percentage who are time-rate workers he receives 11s. 3d. If he works outside the normal hours of the eleven turns, he receives payment at enhanced rates. It is from these various sources—attendance money for no-work turns, the over-riding weekly guarantee when applicable, piecework earnings when applicable, time rate earnings when applicable, and enhanced overtime earnings when such are due—that the dock workers' weekly wages are made up. As has been said, they need never be less than £4 8s. (even for no work at all) and, in fact, they were recently averaging more than £10.

The Dock Labour Scheme is administered by a national board assisted by a number of local boards. The number of the latter, as last published, was 24. The membership of all the boards consists of equal representation of employers and of workpeople. The employers registered in the scheme include port authorities, shipowners, firms of master stevedores, wharfingers, lighterage operators and some others.

The Labour Force.

As mentioned earlier, the Labour Board began its work with a register of about 78,500 dock workers. During the year 1950 the register averaged 75,264. In March, 1950, the Labour Board published a most valuable " Review " of its work over the years 1947-1949 and included the following analysis of the labour force as it was on the 27th December, 1949 :

	Live Register	Suspense Register	Dormant Register	Total
Under 65 years (Group A	50,807	2,141	793	53,741
(Group C	2,902	387	202	3,491
65 to 69 years (Group A	1,845	166	70	2,081
(Group C	1,115	136	51	1,302
70 years and over ...	1,472	150	80	1,702
Temporary workers ...	460	45	-	505
Daily workers	58,601	3,025	1,196	62,822
Weekly workers	11,333	689	6	12,028
Totals	69,934	3,714	1,202	74,850

The basic financial requirement of the Scheme is a regular supply of money from somewhere to pay attendance money to registered men for no-work turns, to provide or make up their guaranteed weekly wage as may be required, and to cover the costs of administration. The Board obtains the necessary funds by requiring every employer of registered labour, for every job done, to pay

Port Economics—continued

more for it than he otherwise would. The employer must pay for the labour at the agreed rate, whatever it may be: and, in addition, he must pay a percentage surcharge to finance the Labour Scheme. In practice, the whole sum is paid by the employer to the local Labour Board whose officers hand to each worker whatever is due to him and retain the balance.

The Levy.

The amount of the percentage surcharge is fixed by the Board. It has been altered, up or down, from time to time: and it also varies in accordance with the category of labour. There are now three rates in operation—the first for non-coastal daily workers, the second for coastal daily workers and the third for weekly workers. There were formerly two rates only—a lower rate for coastal workers having been first introduced as from 1st July, 1950. The three rates then appeared as 15%, 10% and 5%. As from 1st January, 1951, they became 13½%, 9% and 3%. As from 28th April, 1951, they were further reduced to 11%, 7½% and 3%. It is now announced that with effect from 1st June, 1952, they will be 13½%, 9% and 4%.

Composition of the Register.

The live register consists of men who are willing and able to undertake all the duties and are entitled to all the benefits of the Scheme. The suspense register is made up of men temporarily out of action—mostly through sickness or injury. The dormant register comprises men who have been sick for a long time but who may possibly get well again and may claim re-admission to the live register: and some men temporarily in other jobs.

Group A men must report for 11 turns every week, are entitled to attendance money of 5s. for every no-work turn and to the over-riding weekly guarantee of £4 8s. and are liable to transfer within daily travelling distance. Group C men are dock workers who for physical reasons are required to report on only six out of the normal 11 turns each week: in effect, they are part-time workers on reduced guarantees: they now number about 10% of the labour force and consist of aged and other light-work men. The missing Group B was discontinued as from June, 1949: they consisted of men generally able to undertake Group A obligations but unable, for genuine reasons, to transfer from their home ports.

Period transfer—that is to places beyond daily travelling distance—is still a feature of the scheme but is now arranged, when required, on a volunteer basis. Under the Corporation, in the war years, it was compulsory.

The Board's Finances.

For the year 1950, the Board had an excess of income over expenditure on management fund of £861,558: and there was a balance brought forward from 1949 (after making various appropriations) of £325,613. The Board went into the year 1951 with a General Welfare Fund of £379,117, another Welfare Fund of £309,568, a Management Fund balance of £692,881, a Capital Reserve Fund of £413,077, a Depreciation and Replacement Fund of £60,182, and a General Reserve Fund of £1,254,073. The assets side of the balance sheet showed, inter alia, money balances totalling £1,511,098, investments outside the undertaking valued at £1,353,152, and buildings and other possessions worth £409,664. These figures are sufficient to show that the affairs of the Board are conducted with considerable prudence. The view is taken by the managing body that employment in the docks is liable to severe fluctuations and, in consequence, a heavy outlay in attendance money and weekly guarantees may become necessary at any time. In addition, the Board must find the money to pay registered men for six public holidays and—by a recent award—for two weeks annual holiday instead of one. As the national daily time rate was increased by the aforementioned recent award, holiday payments will be heavier. An official estimate puts this increased expenditure, plus the recent increase in national insurance contributions, at £600,000 in a full year. If employment continued high, the employers would be paying higher wages because of the agreed increases in datal rates and piece-rates, and would therefore also pay a greater sum in percentage contributions to the Board. But because the volume of employment has lately fallen and may possibly fall further, the Board has announced the increases in the levy, already referred to, which are to operate from 1st June, 1952.

It will be noted that nearly one-sixth of the registered men are classified as weekly workers. They are men who, by agreement, work for one employer for a minimum period of six months and usually for much longer. Obviously, whilst such an engagement continues, they will cost the Board nothing in attendance money or guaranteed weekly wages and it is for that reason that the Board's levy in respect of such men is put as low as 4% as against 13½% for daily workers. Temporary workers are men brought in from outside the register to work for limited periods to meet local peak demands which are beyond the resources of the local register plus daily-travel men.

Labour Supply.

The National Board has settled a sanctioned strength for each area — the maximum number for which, in the Board's view, regularity of employment may be expected. It is left to the Local Board to adjust recruitment, within that limit, to current needs. Clearly in view of the fact that registration confers entitlement to guaranteed pay, work or no work, the total number of men to be included in the Scheme is of high importance. So also is their fitness for the job, their average age and their loyalty to the requirements of the Scheme.

The Board's " Review—1947/1949," says " There is keen competition to secure a place on the docks. The tradition of the job passing from father to son continues." Out of 6,425 men recruited over two recent years, 3,369 were dockers' sons. Waiting lists exist everywhere and a degree of selection can therefore be practised. The Board has developed its own port medical service as part of a general welfare programme for dockers, and these facilities are also used in some areas in connection with the requirement of a pre-entry medical examination. Eagerness to enter the industry is understandable: according to statistics published by the Ministry of Labour, the average earnings of U.K. dockers towards the end of 1951 were the highest of any workpeople in the country—higher even than those of coalminers, who normally head the list.

There is at present no general insistence on pre-entry training but there is some movement towards it. In the opinion of some, it is the intending specialists, e.g. checkers, cranemen, capstanmen, who particularly need training, and it is a question whether the responsibility belongs to the Labour Board or to the employers in the industry. Cranemen are commonly weekly workers — sometimes not in the Scheme at all, and it is usual for employers to start them as trainees. On the other hand, in 1949, the Board financed training schemes for checkers in several ports.

The labour supply to deal with new jobs as they arise is normally maintained by the twice-daily attendance of unemployed registered workers at the call stands. The employers requiring workpeople are represented there and they select the men they want and set them on—for ship work or shore work as the case may be. A man once set on is generally entitled, if he observes the conditions of agreement, to remain on that particular job while work remains for him to do. Men surplus to local requirements in one place may be transferred, within daily travelling distance, to another place where there is a temporary shortage. The system of calling-on is not rigidly uniform throughout the country and, in the opinion of the Board, there is room for improved methods in some places to secure the highest economic use of labour and to reduce wasted hours to the minimum.

The total register.

The National Board has achieved a high degree of success in the complex and exacting task of fixing and maintaining the total number of workers with a view to achieving the ideal result of (1) enough, but not too many, workers, available at all places and at all times of requirement and (2) giving every registered man full employment. In the excellent " Review " already quoted, the Board have included an analysis of the disposition of the labour force in 1949 which, reduced to approximate percentages, gives the following picture:

Port Economics—continued

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Working	75	72	76	80
Proving attendance	13	9	5	8
Excused	2	1	2	2
Unaccounted	2	1	1	1
Holidays	-	5	5	2
Sick and injured	4	4	3	3
Disputes	1	4	3	1
Weekly workers off work ...	1	2	3	1
Dormant register	2	2	2	2
	100	100	100	100

Progress towards full employment.

Perhaps the most significant figures in the above-given table are those for men proving attendance. The average percentage, over the four quarters of the year, is 9. That is to say, on an average over the year, and throughout the country, out of every 100 men on the total register, only 9 who were able and willing to work failed to get a job. It may interest the reader to look at this figure in the light of Lord Beveridge's report on " Full Employment in a Free Society." He there states " Between the two wars, from 1921 to 1938, the unemployment rate in Great Britain and Northern Ireland, that is to say the percentage unemployed among persons insured against unemployment, averaged 14.2. In the best year, 1927, the rate was just under 10, representing 1,100,000 persons unemployed; in the worst year, 1932, the rate was just over 22, representing over 2,800,000 persons unemployed." And again, " However high the demand for labour, there will always be frictional unemployment in a progressive society subject to seasons and having trade with other countries .....My suggestion is that that we should be able to reduce unemployment to not more than 3 per cent. to cover seasonal slackness, change of jobs and fluctuations of international trade .....This 3 per cent. would consist of a shifting body of short-term unemployed who could be maintained without hardship by unemployment insurance."

Bearing in mind that Lord Beveridge's ideal figure of 3 per cent. is reckoned over all occupations, and considering the high degree of inherent irregularity in dock work, it may be concluded that the Labour Scheme did well to achieve, in 1949, a figure as low as 9 per cent. But the aim is to do better still, always bearing in mind:

(1) The Labour Scheme figure of 9, just as Lord Beveridge's theoretical 3, consists of a " shifting body of short-term unemployed." That is to say, the percentage unemployment represented by the figure 9, consists of a little unemployment spread over a large number of men.

(2) The Beveridge Report proposed, in chief, that the bad old average of 14.2 should be got down to the ideal 3 by " A National Budget based on the datum of man-power and designed to ensure, year by year, total outlay sufficient to set up demand for the whole productive resources of the country." Without any such direct Governmental action, and entirely at the expense of port labour employers, the Dock Labour Board has achieved solid progress towards full employment for its own workpeople (as indicated by the facts and figures given above) and also supports the temporarily unemployed by means of the half-daily attendance payments and the weekly guarantee.

Mechanisation.

A working party set up by the Minister of Transport studied the question of increased mechanisation in the United Kingdom ports from the 25th November 1948 until the 13th February 1950. They concluded that (1) there was plenty of opportunity for more machinery and that it would speed up the work, economise manpower and reduce toil; (2) the workpeople feared its introduction because of possible unemployment; (3) the workpeople therefore clung to practices prejudicial to the use and extension of mechanical equipment; (4) when planning new facilities port authorities should consult with port operators, shipowners, workpeople's representatives and mechanical experts; (5) the fork lift truck offers the greatest scope for speeding-up turnround and lowering handling costs; (6) ship designers should plan the holds so that mechanical equipment can work in them and should give more consideration to the design and layout of derricks, cranes and hatch covers; and (7) U.K. ports need more bulk-handling equipment for grain, oilseeds and iron ore—as may be found (for example) at Rotterdam and Antwerp.

The working party recommended that (1) employers should consult closely with the workpeople concerned prior to introducing new machines in order to explain the method of use and to settle manning and the rates of pay (2) a survey of U.K. ports should be carried out to try to ascertain how much real redundancy of labour would occur if all ports were fully mechanised (3) all concerned should aim at complete flexibility of labour as between ship and shore, and also between gang and gang (4) consideration might be given to the making of allowances to elderly dockers prepared to retire (5) a temporary reduction in the degree of recruitment to the industry might be justified and (6) American and Canadian methods should be studied.

There is a long record of continuous discussion on the subject of increased mechanisation as between the employers and the trade unions in the port industry; but progress is slow. The introduction of an efficient machine would sometimes inevitably mean that fewer men would be required for a given job. On behalf of the employers an assurance has been given that any displacement of men from particular operations by reason of mechanisation would not entail their dismissal from the industry; they would be employed on other work and any contraction of the labour force as a whole following from mechanisation—which would be small and gradual—would be met by normal wastage and, if necessary, a slowing down of recruitment. On behalf of the trade unions it has been urged that the issue of increased mechanisation should be connected directly with the introduction of retirement allowances. The employers cannot accept this new claim; they hold that the two questions are entirely separate and should be dealt with separately. It would appear that until these opposing views are reconciled, the further mechanisation of U.K. ports will not proceed very swiftly. For some detailed description of mechanical cargo-handling, the reader is referred to Chapter IV of the companion volume " Port Operation and Administration," and also to Chapter VII for information regarding the many categories of workpeople, other than dock workers, who are employed in ports and docks. Also in Chapter VII will be found references to the trade unions principally concerned.

Wages, working conditions and incentives.

In his " Introduction to the Study of Labour Problems " (Thomas T. Crowell Company, New York) Gordon S. Watkins has an interesting chapter on the determination of wages. He examines a large number of wage theories, discards some of them and finds no one of them, taken alone, completely satisfactory. He considers (1) the cost of subsistence theory—which postulates that the income of labour is determined by the cost of subsistence of the labourers; (2) the wages-fund doctrine—which states that the rate of wages depends on the proportion that obtains between the population and capital; that is to say, if the amount of capital seeking investment goes ahead of the number of labourers available, wages will rise—and vice versa; (3) the residual claimant theory—which says that when land has had its rent, capital its interest and enterprise its reasonable profit, then labour takes the balance as wages; (4) the specific productivity theory—which lays down that the price of labour, like the value of any commodity, is determined by its own final utility—but the difficulty is to separate the productivity of labour from the productivity attributable to the other factors of production; (5) the normal value or exchange theory—which depends upon the doctrine that a wage consists of two elements, the necessary cost of subsistence plus a reward for the labourer's sacrifice in exchanging present services for future goods; (6) the bargaining theory—which visualises the whole question as a marketing operation between employers and

Port Economics—continued

employees—the result of which will depend upon their respective estimates of the value of the labour, and their respective knowledge and bargaining strength; and (7) the Marxian theory—which declares that labour alone produces all wealth and therefore labour should take the whole product—a theory which no economist accepts.

In a fair attempt to state the essential truth of the matter, Watkins equates the minimum payable wage with the bare cost of keeping alive, and the maximum wage with the whole result of utility and productivity. In terms of economics, every wage ever paid or payable must fall within this range; manifestly, if it drops below the aforementioned minimum, the labour supply will fail and production must cease; if it goes to the maximum—that is, takes the whole value produced—then, equally clearly, there is an end of essential capital equipment, of space in which to operate, of business enterprise producing wage-earning opportunity and of the organising ability which is essential to the creation of wealth of any kind. It is, of course, important to bear in mind that these two limits are themselves variables.

In particular connection with the subject of port labour, the reader is commended to Watkins' concluding words on this important matter. "Much of the misapprehension as to the nature of a reasonable wage will disappear when the humanity concept replaces the commodity concept of labour."

If the record be dispassionately examined, it will be agreed by any unbiassed enquirer that the "humanity concept" has long since been the order of the day in the port industry. The facts and figures given in the foregoing paragraphs carry sufficient testimony but, to summarize and emphasise, the following brief points may be worth noting:

(1) The dock labour scheme itself, by decasualising the workers, was and is a wholly "humanity concept" of labour. It gives certainty for uncertainty, an assured place in industry instead of an insecure foothold, and, in replacement of the old overcrowded arrangements, it offers, to a sufficient registered body of permanent workmen, free medical care, welfare facilities, paid holidays and the opportunity for recreational and cultural activities.

(2) The employers in the industry, besides being the financiers and backers of the Labour Scheme, are also prepared to pay, and have paid, the highest wages known in any U.K. industry in return for efficient work. The incentive of piecerate working is enjoyed by the workpeople over 85 per cent. of the port labour field. Piecerates are fixed and revised by local joint committees—the aim always being to enable a pieceworker to earn a wage exceeding the time-rate by a percentage usually varying between 33⅓ and 50. Extra payments are commonly agreed for dirty, obnoxious or especially difficult cargoes.

(to be continued)

Rebuilding of Corfu Harbour

Good Progress of Reconstruction Works

By R. BUTLER.

The port of Corfu, one of the most completely destroyed in Greece, is fast attaining its pre-war eminence in passengers and trade, as a result of extensive pier and breakwater reconstruction financed by Marshall Aid

Before the war, Corfu ranked fourth among the ports of Greece in passenger traffic and seventh in freight, handling 65,000 passengers and 110,000 tons of goods a year. Following the conclusion of hostilities, traffic was virtually nil for several years, but by the end of 1950 progress had been such that the trade of the port for that year had climbed back to 25,000 passengers and 58,000 tons of freight. Figures for 1951 are not available, but port officials say they will be appreciably higher.

Port facilities at Corfu were not much affected by the bombings which wrecked the city itself, but they were completely destroyed by the departing Germans near the end of the war. With the same thoroughness displayed in the demolition of the Corinth Canal and the Port of Piraeus, German engineers planted heavy explosive charges every ten metres along the quays and breakwaters, and blew everything up in one operation. In all, 470 metres of heavy concrete breakwater were destroyed, together with two main quays and all the customs houses, storage sheds, warehouses and other structures and equipment necessary to port operation.

Fishing boats heading out to sea from the shelter of the new breakwater. Large numbers of caiques tie up in the sheltered harbour in the background.

Recent view of Corfu waterside, showing breakwaters and quays which have already been constructed. Two large passenger ships are discharging offshore.

Officials then had to face two overwhelming tasks simultaneously. The first was the problem of rehabilitating the city itself, one third of which was destroyed by bombing; but unless the port was restored to service at the same time, the very life-blood of the island would be cut off.

The island of Corfu not only contains 105,000 persons — the most densely populated area in Greece short of Athens itself—but it also serves as the major commercial and trading centre for the rest of the Ionian Islands and, in addition, 90 per cent. of the production of Corfu is exported.

In spite of the difficulties confronting them, the port engineers immediately set to work, using the revenues from harbour fees that still remained in the port's funds. With currency depreciation, however, little could be done with this small sum beyond temporary repairs, that enabled caiques to be unloaded by small boats. Worse still with the breakwater demolished, the weather and the sea were fast ruining even what remained of the docksides and quay walls along the waterfront.

Much clearing away and preliminary planning was done, but not until 1949, with advent of the Marshall Plan, could large-scale work begin. By April, 1951, the first phase was completed, with 325 metres of breakwater rebuilt and two piers constructed, one 25 by 20 metres, and the other 20 by 20 metres. A customs office and an unloading shed was also built.

Rebuilding of Corfu Harbour—continued

As a result the port is again workable and plans have been prepared for more construction work to complete both restoration and modernisation proposals, which will be put in hand when the necessary funds are available.

More breakwaters are needed and it will be desirable to have eventually at least one quay at which large vessels can tie up. At present the bigger ships must anchor offshore and discharge passengers and goods from lighters, which is unsatisfactory, considering Corfu's position as a premier tourist attraction, but caiques can use the port, and they now handle most of the trade.

Corfu's main exports are oil from the three million olive trees, rope from a large manufacturing plant, fruits and fresh vegetables, and flour. Wheat is brought to Corfu for grinding, and the flour goes out to feed the other Ionian Islands and a large part of Epirus on the mainland. More than half the port's traffic last year was in wheat or flour.

The islanders also look for a quick revival of the tourist trade which put so much money in their pockets before the war. Corfu ranks with Rhodes and Cyprus as among the choicest holiday spots in the eastern Mediterranean, and many thousands of foreign visitors and Greeks have enjoyed its scenic attractions, historical associations and lush greenery, remarkable in sun-parched Greece.

The tourists are returning gradually and with one new hotel completed and another large one almost ready, the port will soon be able to receive even greater numbers.

Argentine Port Works

Recent Developments carried out by the Ministry of Public Works *

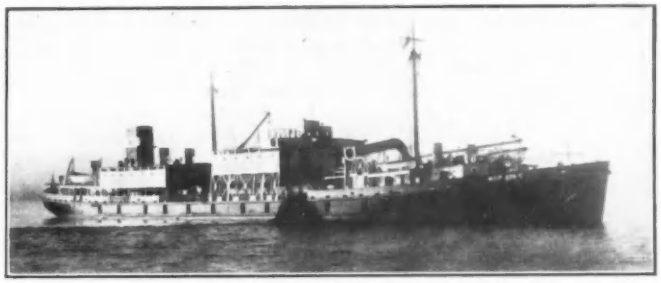
The Argentine Minister of Public Works, General Juan Pistarini, acting through the National Organization of Harbour Construction and Navigable Waterways (formerly the National Organization of Navigation and Ports), has been responsible during the last few years for the important task of improving river navigation and navigable waterways, the construction of ports, and the perfecting of dredging equipment.

Several large dredgers have been purchased abroad, and interesting details have been given of these. The *President Peron*, built in the United States, and costing 15,000,000 pesos (the peso is worth about sixpence), was put into service in 1948. This suction dredger can pump dredged material through a horizontal distance of 5,000 metres, and has a maximum output of 800 cubic metres per hour in coarse material, and of 1,200 cubic metres an hour in sand. The dredger works for 24 hours a day on four shifts with a crew of 110 men, and is equipped with a total installed horsepower of 8,000 being able to dredge to a maximum depth of 16.5 metres, the diameter of the dredging pipe and discharge line being 711 mm. Up to March, 1951, the vessel had dredged 5,900,000 cubic metres, mainly in coarse material, excavating a channel close to the shore, and at the same time reclaiming adjacent ground to the east and contributing to the development of the northern district of the city of Buenos Aires.

The large dredger of the same type, the *Ministro Pistarini*, has been employed during 1951 in reclamation work in the Nuñez district, and this vessel can also pump dredged material to a horizontal distance of 5,000 metres. It has a maximum output of 800 cubic metres an hour in coarse material, and of 1,200 cubic metres an hour in sand, the total installed horsepower being 6,500, the maximum dredging depth 18 metres, and the diameter of the dredging and discharge tubes 711 mm. Up to March ,1951, it had dredged a total of 4,700,000 cubic metres of material, and like the *President Peron*, it works on a four-shift basis with a crew of 110 men.

The bucket dredger *Stella Maris* was bought by the Ministry of Public Works for the special task of dredging sand and gravel in the river Uruquay. The Ministry has also purchased from abroad the large drag suction dredgers *La Descamisada* and the *Miguel Miranda*, together with the dredger *Libertador General San Martin* which was built in Holland and put into service in July, 1950. It is a drag suction dredger and has been working on the channels of Punta del Indio and Tipo. It is able to fill her hold with 2,000 cubic metres of dredged material in 20 minutes, and has an effective dredging output of 50,000 cubic metres in eight hours of continuous operation.

The diesel-electric dredger *M.O.P. 228-C* is of particular interest, because she is one of four such vessels built for the Argentine Ministry of Public Works by Fleming and Ferguson, Ltd., and William Simons and Co., Ltd. Many new features have been



The diesel-electric dredger *M.O.P. 228-C*.

incorporated, the most notable being hydraulic control, whereby practically every dredging operation can be controlled from a panel in the wheelhouse. From this panel the dredge master is able to control the lowering of the suction pipe and the position of the draghead, indicators showing the position of the mechanism and also which valves are open or closed and to what extent. Dredged soil can either be discharged overboard or into hoppers arranged on either side of the ladder well. The doors controlling the entry of the spoil to the hoppers are operated hydraulically, but they are controlled locally, since the filling of the hoppers cannot be effectively supervised from the control panel; alternatively, the hoppers may be emptied by pumping the spoil overboard through a main suction duct, the doors leading to the latter being also hydraulically operated with local control.

The hoppers have a capacity of 3,000 tons and are arranged on either side of the ladder well, being fitted with hinged bottom doors which are opened and closed by means of bridles and chains attached to the fore and aft drawbars operated by hydraulic rams. This particular vessel has a length of 328-ft. between perpendiculars, a breadth moulded of 53.5-ft. and a depth moulded of 24-ft., the loaded draught being 17.3-ft. and the maximum dredging depth 49-ft.; while the speed is 11½ knots

The dredging pumps have volutes of fabricated mild steel, fully lined internally with plates of high-tensile steel to withstand the abrasive action of the dredged spoil, the four-bladed pump impellers being of nickel-chrome alloy steel. The dredging pumps discharge to a common main which divides at main deck level into four launders, fitted with hydraulically operated doors opening into the hoppers. When used for land reclamation work, the dredging pumps draw the spoil from the hoppers through the suction keelsons, which run fore and aft between the bottom doors at each side of the hoppers. The four main oil engines have a service rating of 1,120 brake horsepower at a speed of 700 r.pm., driving generators rated at 770-kW. supplying current at 220-230-volts, D.C. Power from these main generators is available either for propulsion or for pumping.

One of the most interesting points to bear in mind is that the hull of this type of vessel is subjected to severe strain by the rapidity with which the hopper can be filled or discharged. In order to avoid any possibility of misalignment between engines and their respective generators, each engine and generator unit is built as a single unit, flanged and bolted together.

The *M.O.P. 228-C* arrived in Argentine in June, 1950. It has a dredging capacity of 50,000 cubic metres of spoil in eight hours of effective work. Another suction dredger *La Plata* has a hopper capacity of 1,200 cubic metres, and two more vessels of similar dimensions are now under construction.

*Translated from the Argentine journal *La Ingenieria* for January—February, 1951, by Rolt Hammond, A.C.G.I., A.M.I.C.E.

Argentine Port Works—continued

Auxiliary Vessels

The Ministry of Public Works also owns a considerable fleet of auxiliary vessels, and some notes are given about these which may be of interest as indicating the wide administration of the Ministry. There are ten self-propelled hoppers each having a capacity of 200 cubic metres for the transport of dredged soil to dumping grounds. Built in Italy, they were put into service in 1950, and work in conjunction with the bucket dredgers. Four coasters were built for the Ministry in the United States, each with a deadweight carrying capacity of 1,000 tons, propelled by a pair of oil engines, each developing 350 horsepower at a speed of 360 r.p.m.; the average speed is 16 kilometres per hour and the maximum draught is 2.74 metres. These vessels were delivered in 1949. A further eight motor coasters, built in Italy, of the same deadweight carrying capacity and propelled by machinery of the same power, and having the same maximum draught, were delivered in 1950.

There are also five pusher tugs, all built in the United States, four having been delivered in 1947 and one in 1949; the former are equipped with engines developing from 700 to 1,000 horsepower and the latter is powered by an engine of 760 horsepower.

There are also 35 barges of steel construction, each with a deadweight carrying capacity of 1,000 tons, owned and operated by the Administration of River Transport, prefabricated units of which were shipped from the United States and assembled and welded in the building yards of the Ministry of Public Works, or were constructed by outside contractors in their own shipyards between the years 1948 and 1950. This same authority has 24 steel barges for carrying cargoes up to 600 tons, which were built in a similar manner and completed during the years 1948-1950.

It is interesting to note that there are 14 towed barges of special design, which were adapted in the Central Workshops of the Ministry for the transport of motor vehicles of all sizes and types. These barges are employed on the Parana-Santa Fe and Corrientes-Barranqueras routes respectively and were put into service in 1949. The capacity of the pusher tugs to deal with large cargoes is well illustrated by the fact that a normal convoy consists of nine steel barges, three of 1,000 tons and six of 600 tons, representing a total load of 6,600 tons, loaded with sand and propelled by a pusher tug equipped with an oil engine of from 700 to 1,000 horsepower.

The Central Workshops of the Ministry have also been responsible for the construction of large numbers of self-propelled steel barges with tonnages of 85 to 400 tons. In addition, the workshops undertook the assembly and welding of 50 steel barges, shipped in prefabricated sections from the United States, 14 of these vessels being of 600 tons and 45 of 1,000 tons, which are owned and operated by the Administration of River Transport.

New Cranes Purchased

The Ministry has devoted particular attention to the ample provision of cranage, and in this respect it is interesting to note that 128 cranes of various types have been purchased from Italy; they include portal, semi-portal, locomotive, electric and diesel-electric models, all of which were assembled in the country. There are five diesel-electric floating cranes each of 30 tons lifting capacity, which were purchased in the United States and were erected in the Central Workshops and also at Rosario by the Ministry; they were put into service in 1949 and 1950.

Reclamation Works Undertaken

The possession of the two large suction dredgers to which reference has already been made, has enabled very large reclamation works to be undertaken at Rio Santiago and at the Central Workshops, and especially for the development of the north bank of the River Plate. At Rio Santiago, reclamation over an area of 41 hectares has been undertaken by the dredger *President Peron* to provide ground for the large workshops of the Ministry of Marine now under construction. The spoil was dredged from the channel of the river Santiago and from the site of a new dock, the latter providing access for transatlantic vessels bringing in plant and and machinery for the naval arsenal. The total area reclaimed from the river is about 264 acres and its value is estimated at about 528,000,000 pesos, being a valuable addition to the national wealth.

Considerable reclamation has been effected by means of spoil dredged by the *President Peron* and the *Ministro Pistarini* near the dock to the east on Demarchi island. Two new islands have been formed by the *Ministro Pistarini* in the course of dredging the access channel to dock " F " representing a volume of material of 1,300,000 cubic metres in a period of six months, the channel passing between the islands. This work was carried out in 1949-50. These two dredgers have also been employed on reclamation work connected with the town planning scheme on the north bank of the River Plate at Nuñez, which has included the construction of a bathing lake covering an area of 19 hectares, work which was carried out between 1947 and 1950.

Protection Works

The protective jetty on the east side of the entrance channel to the Port of La Plata has been reconstructed, both for protecting navigation and to effect an appreciable reduction in the maintenance of the embankment of this channel, work which was carried out during 1950 and 1951. The structure of this jetty consists of substantial timber frames with rock filling laid between the side planking. Another important reconstruction work comprises 669 metres of wall on the east and west sides of the large dock of the port of La Plata, the value of work done during 1951 representing 25,000,000 pesos. In addition, 760 metres of retaining wall have been completed in Dock " F," which is reserved for the river fleet of the Ministry of Public Works and this work was undertaken during the three years from 1948 to 1951.

It is noteworthy that the new drag suction dredgers are very much more powerful than the original plant employed for dredging, and they have enabled continual deepening of the channels to be carried out so that access to the port may be improved. This work had previously been rendered difficult by the advent of the second world war which curtailed the supply of replacements and spare parts.

Pusher tugs and barges have contributed towards the creation of a river fleet, and they have the great advantage of not requiring special dredging. During the year 1950, this means of transport was responsible for the conveyance of more than 1,250,000 tons of goods at a cost below that of any other alternative method of transport, the revenue from which amounted to 7,500,000 pesos. The large reclamation works carried out on the north bank of the River Plate have added an area of about 200 hectares in one of the most useful and valuable districts of the city of Buenos Aires.

The terminal port of the river fleet is now under construction at dock " F," and there are also important works proceeding at Iguazu, Commodoro Rivadavia, Concordia and Corrientes. The The dock berths at Zarate and Parada Cagnoni, as well as dredging of the Irigoyen Channel have facilitated the construction of a section of highway for a distance of 15 kms. between Zarate and Parada Cagnoni, which will be completed shortly.

New Type Ore Carrier Launched.

The self-unloading Ore Carrier, " Carl Schmedeman " (15,000 tons gross) was launched early last month from the Shipyard of Vickers-Armstrongs, Ltd., Barrow-in-Furness. This ship, which will be used to transport bauxite from Jamaica to ports in the U.S.A., is part of a programme estimated to cost a total of $14,500,000 which is being undertaken in Jamaica by Reynolds Jamaica Mines, Ltd., for the development of the island's bauxite resources. The new vessel is the first self-unloading Ore Carrier to be employed in the Aluminium Industry. The ore will be discharged from the ship's holds on to conveyor belts, which will carry it to the stern, where it will be unloaded by conveyor to shore facilities.

By means of this novel unloading system the entire ship's cargo of 12,500 tons can be transferred from ship to shore in about nine hours at the rate of approximately 1,400 tons per hour. A conventional ore ship of this size unloaded by clam buckets would require about two days for discharge. The new method will save at least two full days in turn-round time at Gulf Ports.

Cargo Handling Conference

Synopses of Papers Read at International Meeting

(By a Special Correspondent)

The first Technical Conference of the International Cargo Handling Co-ordination Association, brief details of which were announced in the April 1952 issue of this Journal, was held in Rotterdam from 12th to 14th May, 1952, and was attended by about 150 delegates from Belgium, Denmark, France, Germany, Great Britain, Holland, Italy, Norway, Portugal, Spain, Sweden and the U.S.A.

The delegates were welcomed by Rear-Admiral A. L. P. Mark-Wardlaw, the president of the executive committee, after which, in a joint paper, Messrs. A. C. Hardy (chief co-ordinator) and X. le Bourgeois gave an account of the present position of the Association and its aims.

They pointed out that the age of " any type of goods in any type of ship " was fast disappearing and that ship construction was beginning to be governed by the nature of the cargo she could carry. Ports, too, might have to be divided into specialised zones in which everything was arranged for a particular cargo. Both speakers emphasised that mechanisation was not the sole aim of the Association, rather was it the desire to aid everyone to do their job more efficiently by making available all possible information on every aspect of their work.

The dockers were an important factor in the problem of cargo handling and the Association would use every means to ensure that they were generally recognised as skilled workers. The question was not for or against mechanical handling, but what form of mechanical aid was most suitable for a particular work. Generally speaking however, the port remained the essential element in the problem of the slow turn-round of shipping, and no matter what mechanical aids were introduced, their ultimate usefulness would depend upon the men operating them.

The Value of the Fork-Lift Truck

Col. R. T. Hartmann (London) then read a paper on " The Importance of the Fork-Lift Truck and Unit Load System in Cargo Handling," and said that despite considerable development in the design of cargo and other vessels, including a material increase in speed, thus reducing the time spent on voyages between ports, the actual loading and discharging of cargoes in many instances remained virtually the same as in the days of the sailing ships. In fact it had recently been claimed that the general rate of loading and discharging in many ports, was no higher, per gang hour, than it was 40 or 50 years ago. At the same time, however, handling costs had increased enormously by reason of the continued increase in operational costs, including labour rates, etc.

Generally speaking, transport undertakings, and in particular shipowners, and stevedoring concerns, when considering the use of mechanical handling equipment for loading, unloading and storing cargoes, must have regard to the fact that normally this presented a much more complex problem than in industry.

As a rule, in factories, and plants, it was possible to standardize on a certain type of mechanical handling equipment which experience had shown was best suited to the particular nature of the raw materials and finished products which continually and regularly passed through the plant.

In contrast to this, however, transport concerns, shippers, and stevedores, must usually be prepared to handle, possibly at short notice, multifarious types of cargoes packed in a variety of ways, and as a consequence it was essential that the equipment used should be readily adaptable to meet economically all requirements.

The aim to-day of every modern industrial plant was to achieve the optimum whereby from the raw materials, to the finished product, practically no single item was manhandled. The same could not however be said of the cargo handling industry where the amount of mechanical handling equipment in use, broadly speaking, was still small, and the labour force, by industrial standards, was still alarmingly high.

It was the comparatively recent advent of the fork-lift truck with various loading capacities, coupled with the pallet, or unit load, system, which rendered possible a complete revolution in cargo handling technique.

Only experience and the nature of the cargoes to be handled and the circumstances under which the trucks were called upon to operate could determine the types, or variety of types best suited for any particular purpose.

Even in cargo vessels of conventional design increasing use was being made of easily manœuvrable and small battery-operated fork-lift trucks which were lowered into the hold by crane or ship's gear, to handle and stack cargoes which had been lowered into the holds by slings in the customary manner.

One aspect of cargo handling which it was felt did not always have the attention it deserved, was the proper utilization of warehouse space at the docks. It frequently happened that warehouses were regarded as being full to capacity when all the available floor space had been occupied by potential cargoes stacked to the height of a few feet.

Even if the docks be equipped with the latest types of cranes, gantrys, conveyors and other equipment, they could not be said to be "mechanised" in the most economical manner, if the method of storing the cargoes in the warehouses was such as only permits of " floor space," and not " cubic space," being utilized to its maximum capacity.

Continuing, Col. Hartmann said that it must be candidly admitted that no real progress could be made in substituting modern methods, for the archaic methods so frequently employed, so long as dockers remained antagonistic to any form of mechanization which may result in redundancy.

It seemed logical to him, however, that if a carefully prepared and universal plant were devised for the use of mechanical handling equipment generally, at all docks where appropriate, it should be possible to retain most, if not all the suitable dock labour now employed, and at wages comparable to those at present being earned. Although mechanical handling equipment obviously reduced the number of men required, it still required the human element to operate it. In theory, therefore, it was a question of relating, and integrating, three prime factors—the maximum tonnage which it was desired to handle, the type and quantity of mechanical handling equipment required for that purpose, and finally the number of men necessary to operate such equipment.

To be effective, such a scheme would, of course, require the active joint collaboration of the dock employers, the unions, and the manufacturers of the mechanical handling equipment. Moreover, its success would largely depend upon simultaneous application, since a certain amount of re-deployment of labour would be inevitable.

If intelligently and efficiently initiated such a scheme should materially reduce the present cost of cargo handling, and effect a quicker turn-round in shipping, without unduly affecting the employment, or the rates of pay, of dock labour. In view of the potential benefits to the nation from high productivity due to mechanisation, trade unions should encourage the development of " machine-consciousness " amongst their members, and should co-operate actively, and earnestly, at all levels, with local managements, in the introduction of mechanical equipment for freight handling. Equally, managements should endeavour, by giving a clear explanation of their intention to mechanise, to persuade their employees readily to accept the new methods.

In conclusion, the speaker said, " Both sides of industry should join in pubicising the fact that there is nothing new nor frightening in the idea of mechanisation. From earliest times it has been an integral part of national and industrial development. Some new mechanical devices, although perhaps resisted at first, become accepted by later generations, as contributing towards an improved standard of living, and to the avoidance of industrial fatigue. In fact, industrial well-being is dependent upon such progress.

" Intensive propaganda along these lines should be undertaken nationally by industry, and the appropriate Government departments, in an endeavour to put mechanisation issues in the right perspective.

" In introducing mechanisation, just as much attention should be given to the sympathetic and sensible re-deployment of the workers concerned, as to the selection and installation of the machinery itself. By local consultation between management and men it should normally be possible either to align each progressive

Cargo Handling Conference—continued

development with the normal rate of manpower wastage, or to re-absorb any redundant labour in another part of the industry."

Rotterdam's Port Facilities

The second paper, entitled " Turn-round in the Port of Rotterdam," by Ir. N. Th. Koomans, described the modern facilities available at that port. The speaker said that the number and tonnage of ships entering the port and the quantity of goods handled placed Rotterdam among the major ports of Europe. The concentration of such a large amount of traffic was due to the fact that Rotterdam is situated in the estuary of the Rhine which river is navigable for big lighters of 1,500 tons and motorships of 800-1,200 tons as far as Basle in Switzerland—a distance of 530 miles. About 50 to 60 per cent. of the Rotterdam traffic was transhipped directly from sea-going ship to Rhine barge or vice versa.

A large proportion of the cargo which was landed was scheduled to continue its journey eventually by inland craft. Only a comparatively small part of the cargo passing through Rotterdam (about five or six million tons) was moved away from the port by road or rail.

The roads, docks and wharves were constructed by the municipality, while some of the wharves had been equipped with transit sheds, warehouses and cranes which were leased on short term to the users of the port. Many of the wharves were, however, on long term lease to shipowners, etc. who had built their own warehouses and installed cranes. Of the 250 electric portal cranes in the port 100 were owned by the municipality. All floating equipment, 50 portal cranes and all loading bridges were owned by private firms. Tug services were also in the hands of private firms.

Referring to the port's Customs system, Mr. Koomans said they had considered whether it would be wise to arrange for a free-port zone, but after careful examination of the matter they had found that the prevailing regulations, as far as Customs were concerned, left them considerable freedom of action, not only for the storage of goods on which duty had to be paid, but also for industries situated in the vicinity of the port, using chargeable raw materials and working both for home and foreign market.

Cargo Handling Problems

At the morning session on the following day, two further papers were presented. The first, by Ir. W. A. Kruyff, was entitled, "A Shipowner's Ideas about Modern Cargo Handling Methods," and the speaker pointed out that during recent years, it had been the experience of shipping companies that the benefit of greater ocean speed had been cancelled out to a large extent by long delays in port. That more than anything else, had forced operators to seek other means of turning the ships round in shorter time.

In the company with which he was connected the total time in port in some services occupied up to 50 per cent. of the total round-trip duration. If they were able to increase the speed of a given vessel by a few knots they would be able to save only a few days on the outward and homeward voyages. During the coastwise trip between the various discharging ports overseas the greater speed of the vessel would not bring about much saving in time, because of the relatively short distances between ports.

It was gratifying that improvements were still within the realm of possibilities. The application of various types of cargo-handling equipment had already been instrumental in bringing about greater efficiency, and so in reducing time in port. Besides, the design of modern ships was gradually undergoing changes, but in that respect there was still much room for improvement.

Among the modern mechanical means which were available for stepping up efficiency in cargo handling the **fork-truck** led the procession. Another interesting feature was the combination of the fork-truck/pallet operation with the use of **small trailers.** Very often fork-trucks were used to move cargo over considerable distances. In order to obtain the highest possible speed of loading or discharging, it became necessary to press more trucks into the operation. In ultimate analysis this became an investment problem and an operator might find that the much publicised economy of the fork-truck was not nearly as favourable as he had been led to believe.

The overall efficiency could be materially increased if the long-distance travelling was done by means of **trailer trains** with the aid of small tractors, the fork-trucks confining mainly to the task of loading and unloading the trailers, and piling or unpiling the cargo in the warehouse. The tractor's prime purposes was to shunt the trailer trains back and forth between the ship's side and the warehouse, and by rotating the trailer trains, a fairly continuous operation could be accomplished, as one tractor could keep three or more trailer trains in constant operation and could also serve one or more hatches.

Various types of *cargo conveyors* have proved to be very efficient, although there seemed to be a tendency towards the belief that a cargo conveyor should only be used as a substitute for the ship's own loading gear or shore cranes. While the heavy cargo must of necessity be handled by the ship's gear or shore cranes, the possibilities which conveyors can offer was often overlooked. A mobile conveyor could supplement and boost the productive capacity of a given hold in the sense of its loading or discharging rate. In larger ships this could be accomplished in conjunction with the use of sideports, while in smaller ships light cargo could be fed into the vessel by the use of a mobile conveyor on the quay which lifted the cargo over the ship's rail, and combined with gravity rollers or chutes, carried it to the point of stowage.

Dealing with ship design, he said that during recent years many owners had become aware of the apparent inconsistency of installing the ship's engine amidships. Port records showed that the best loading and discharging performances were obtained amidships where the holds were nearly cube-shaped. Sharp fore and aft cargo holds and the propeller shaft tunnels impeded the efficiency of stowage and handling of the cargo.

With regard to ships' hatches, the speaker said that a considerable amount of time was lost in every port of call in the course of opening and closing hatches and the cumbersome operation of removing and replacing hatch beams and covers. The accumulation of hours lost in each port could mean a loss of several days during a round-trip. He thought that a device by which hatches could be opened and closed mechanically would be adopted for most new tonnage in times to come, and shipping companies which carry valuable mixed general cargoes would be well advised to study the matter.

The Human Element in Cargo Handling.

In another paper, entitled " The Human Element," Dr. J. Ph. Backx, of Rotterdam, said the problem of human relations in connection with cargo handling was two-fold. In the first place there was the general aspect, identical in all industries. In the second place there were the special labour problems of the port industry alone.

It was a curious paradox that the mechanisation of industry actually increased the importance of the human problem, since the adjustment of men to highly mechanised work by its very nature and scale required a high degree of co-operation.

Development of improved methods of work and organisation had been inhibited by resistance on the part of the workers. Efforts to meet the workers' need for greater security have concentrated on increasing their economic security. Though greatly appreciated, economic security appeared to be an inadequate basis on which to meet the manifold uncertainties of dock work. Contact between employers and workers seemed very deficient and this deficiency the primary obstacle to better understanding.

To this may be added the bitter legacies of the past. To-day, managers still pay for the mistakes made by their predecessors and the often inborn distrust which most workers feel against management and which was due to past experiences was one of the most difficult obstacles to be overcome by managers and workers.

Dr. Backx then made some suggestions which he thought would improve working conditions. These included the setting up of an organisation of casual labour which would provide, as nearly as possible, the advantages associated with regular employment; uniform training in a training school for port workers; the provision of canteens, with washrooms and cloakrooms; accident prevention; and joint consultations.

The main value of joint consultation did not lie in the suggestions

Cargo Handling Conference—continued

which might be made for improvement in production, but in the fact that the worker wanted to have a real sense of participation in the organisation, that satisfied, in some measure, the human desire to be personally identified with the project in which he was engaged. The value of joint consultation should be seen quite simply. It lay in enabling the worker on the floor to participate in the decisions that affected his work and well-being, and to attach a value to, and take an interest in his work and surroundings as part of the firm.

On the management side, joint consultation should be carried out quite sincerely, with open motives, unreservedly and regularly. In that way only the old and persistent feeling of distrust could be dispelled and give way to a sense of understanding and confidence.

In his final remarks, Dr. Backx referred to mechanisation and said that every new step in that direction would confront them with the problem whether the workers would co-operate or resent the use of further machines. One side of the problem was comparatively easy. There were many technical devices which could make manual work easier. The other aspect, labour saving, was more difficult. Here management had to consider the workers in the planning at an early stage. The nature of the change was often of much less importance than the mere fact of a change and the manner of its introduction. It must be realised that changed systems in themselves were less important than the frame of mind, in which the human element was viewed. Workers were far more sensitive to the motives of their management than was often assumed.

Loading and Discharge of Cargo

On the third day for their final session, the delegates returned to Rotterdam when the loading and discharge of goods at open roadsteads and the handling of dangerous cargoes were the subjects under review.

Presenting his paper on " Open Water Loading and Discharge," Commander A. C. Charvet (French Navy) said that in tropical and sub-tropical regions, many of the ports were only able to cope with vessels of medium size, and there were no facilities for the berthing of large vessels. Stevedoring operations were carried out by a shuttle service of lighters between the ships anchored in the roadstead and the wharves or quays.

Research undertaken by shipowners all over the world, with a view to finding out the cause of delays in ports where there were no berthing facilities, had shown that there was a considerable disparity between the present potentiality of the ports and the size of the traffic through them.

Summarising the results of this research the speaker pointed out that in the loading and discharge of cargo in open water ports the following difficulties are encountered :

(1) Insufficient quantity and quality of lighterage and hoisting gear.

(2) Lack of warehouses and insufficiently organised methods of exploitation.

(3) The bad state of roads and lack of rolling stock.

(4) Mediocre quality of the labour force.

Sometimes satisfactory results were obtained when there were only a small number of ships to be handled in the roadstead at any one time; and from that it might be inferred that a more detailed study of ships' schedules would result in a higher output at those ports. But there were several obstacles in the way of reorganising ships schedules in order to ensure regular intervals between calls.

The Carriage of Dangerous Goods

Presenting his paper on " Dangerous Goods," Dr. Jules Aeby (Antwerp) said that a thorough knowledge of all goods commonly carried by ships was necessary to facilitate and accelerate their handling in ports and thus to contribute towards the speeding up of operations.

The speaker then gave a very complete list of the more important literature published throughout the world on the subject of dangerous goods. Among the goods subject to self-heating he made special mention of fibre jute which, of late, was all to often found in the casualty lists. As far as coal and cotton are concerned, the speaker said that these two commodities were the most frequent items in fire hazard, and no efforts had been spared to find remedies, so far without definite result.

In conclusion, Dr. Aeby suggested that a " working plan " might be put into effect internationally to pool the knowledge and experience of shipowners, underwriters and manufacturers. The objects would include :

(1) Tabulate all commodities commonly carried in sea transport by examining the official and unofficial literature, freight tariffs, manufacturers' and insurance companies lists.
(2) Give for each commodity as many synonyms and alternatives as possible, not forgetting trade names.
(3) Whenever possible, give chemical formula as this makes for international identification for chemists the world over.
(4) State whether the commodity is solid, liquid or gaseous.
(5) Give a short description of nature and eventual inconvenience, risk or danger.
(6) Suggestions for packing or compulsory measures.
(7) Recommendations as to stowage.
(8) Whole text in English and French and perhaps in other languages as well.
(9) Study marine casualties.
(10) Create a complete alphabetical and internationally comprehensive index.

Modified Underwater Television

A new underwater television camera in modified form has been developed to Admiralty specifications by Pye, Ltd., of Cambridge. A complete set of this equipment has been assembled and is to undergo sea trials in the salvage vessel *Reclaim*, while a second camera has been ordered to be used for experimental work at the Admiralty Research Laboratory, where a different type of casing is being developed.

Both these cameras have built-in facilities for changing lenses, focus and aperture under water by means of remote control, and have special lighting equipment. They have a maximum visual field of 70 deg. and can operate at depths of 1,000 feet. Stability of the watertight casing is provided by a large fin attached to the exterior of the casing, to facilitate the use of the camera in difficult tidal conditions. This fin also serves for mounting the lighting.

The principles of the equipment are the result of lessons learned in the identification of the submarine H.M.S. *Affray*, details of which were published in our May issue. It will be remembered that the submarine was recognised with the aid of improvised apparatus and a Marconi television camera. Owing to the compact shape of the new equipment, which avoids the use of an unwieldy external framework, it is expected to be easier to handle at sea.

In a paper on Underwater Television, Mr. W. R. Stamp, of the Royal Naval Scientific Service at the Admiralty Research Laboratory, stated that in the future there would be developments in the operating of underwater television at depths greater than 1,000 feet, and of remotely-controlled salvage tools in conjunction with underwater television. Thus, there was the possibility of the salvage of cargoes, etc. from great depths with much better facility than at present. He said that during the search for the submarine *Affray*, the television camera was operated for over 300 hours underwater, and further extensive trials undertaken by the R.N.S.S. with two cameras, have served to evaluate the scope and limits of underwater television. These trials, so far, are the first to be carried out in this country.

Reconstruction of Dundee Wharf.

A start has been made with dredging and demolition work at Western Wharf, Dundee, which is to be reconstructed at an estimated cost of £390,000. The new berth is being dredged to give 25-ft. alongside at L.W.O.S.T., and the present shallow transit sheds are being taken down and the materials stored for possible future use.

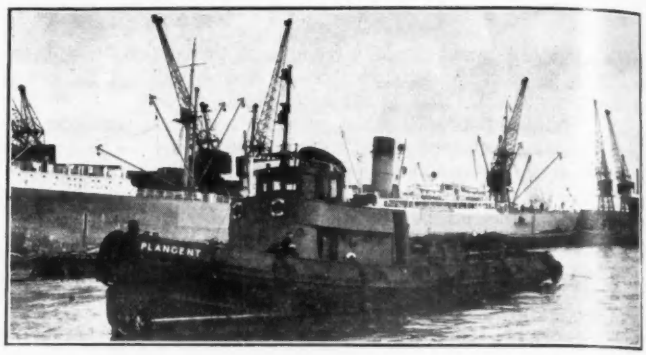
Ship Handling in London Docks

Tugs are an important agent for the efficient handling of ships on the River Thames, and many tugs are exclusively employed in handling ships within the dock system, where they move ocean-going ships and deliver them to the locks, at which point they are met by river tugs which take them down to Tilbury.

It is part of the policy of the Port of London Authority to maintain a fleet of the most modern tugs for this purpose, and orders were recently placed for the construction of four twin-screw oil-engined tugs of what is known as " Plagal " class (named after the prototype ship.) Two of the ships in this building programme have been delivered by Richard Dunston Limited, and since going into commission, have been used for the purpose of berthing the large cargo and passenger liners using the Royal Docks.

Some weeks ago, a demonstration was given by the " Plangent," the second ship of the class. These tugs do as many as nine tows in their daily duties, at present limited to about nine hours, while crews for the tugs now building are being trained; this will later enable them to operate on a three-shift basis.

As only steam tugs have been used hitherto for this work, the performance of these new Crossley-engined tugs has been watched with keen interest. During the demonstration run in the Royal Docks, the tugmaster of the " Plangent " stated that manœuvrability was a very strong point in their favour and response to telegraph orders was immediate. With regard to fuel economy, the master instanced a typical day when his tug moved seven passenger/cargo liners during the course of the day's duties, which commenced at 6 a.m. and ended at 7 p.m. In that period of time, the two main diesel engines (a total power of 1200 b.h.p.) consumed one ton of oil, whereas the same duties carried out by a steam tug, such as the P.L.A. tug " Beverley," would have resulted in a consumption of from eight to ten tons of coal.



The tugs of the Plagel class are 85-ft. in length, 24-ft. in breadth moulded, with 12-ft. 6-in. moulded depth and a draft of 7-ft. 9-in. forward and 12-ft. 2-in. aft, on a displacement of 328 tons. The designed speed is ten knots, and the propelling machinery consists of two Crossley diesel-engines, each developing 600 b.h.p. at 250 r.p.m.

Day accommodation and lockers are provided for three shifts to enable the crew to maintain a 24-hour service. A modern appearance has been incorporated in the design, and an item particularly worth noting is the clear view given from the navigating bridge.

In addition to the tugs described above, Crossley Bros., Ltd., have also supplied machinery to a number of other tugs owned by the P.L.A. A 600 h.p. single-screw motor tug is now under construction, whilst, at present in service, are four launch-tugs, one of 150 h.p., two of 90 h.p., and one of 120 h.p.

Manufacturers' Announcements

Heavy-Duty Fork-Lift Truck

A demonstration was recently given of the S.D. freight-lifter heavy-duty fork-lift truck, which has been designed and built by Messrs. Shelvoke and Drewry, Ltd., Letchworth, Herts.

It is well known that the original conception of heavy materials handling equipment of this calibre came from the United States of America, but as a result of the application of over 30 years' extensive engineering experience to the problem, Shelvoke and Drewry claim that they have succeeded in producing a fork-lift truck for handling the exceptionally heavy load of 18,000 lb. with an appearance and performance which is second to none in any country in the world.

Perhaps the greatest advantage of the S.D. freightlifter is its ability, not only to safely handle heavy and unwieldy loads, but to operate in outside yards on uneven surfaces, thus permitting modern mechanisation methods to be applied to trades where hitherto the inherent limitations of smaller trucks made this impracticable, notably in timber yards, pre-cast concrete yards, heavy industry factories, docks, etc.

The fact that the loads to be carried are in many cases up to 30-ft. in length, and may have to be stacked to a considerable height, made it imperative to give meticulous care to the design of the frame, axles and suspension to ensure complete stability under all conditions, and the specially positioned tilt cylinder is a unique feature providing an exceptionally high standard of safety and positive load control.

" Freightlifter " lifting loaded lorry to a height of 20-ft.

An impressive feature of this heavy truck is its effortless manœuvrability, it being as easy to drive as the average motor car, the steering being hydraulically assisted and so reducing physical effort to a minimum. The massive strength of the chassis, mast, carriage and hydraulic equipment, which enables a load of 8 tons to be lifted to a height of 20-ft., is also worthy of note.

The B. & A. Automatic Grabline

The B. & A. Engineering Co., Ltd. of London has recently developed a special device for preventing grabs from twisting, which is claimed to be of considerable value in increasing the output of grab cranes where they have to discharge into vehicles or hoppers of limited size.

The device which is known as the " B. and A " automatic grabline can be attached to a crane jib to prevent the twisting and swinging of grabs or buckets. This is very useful where the grab is dumping into lorries or small hoppers, as, by its steadying action it ensures that the long side of the grab and long side of the receptacle are always in line. It thus assists sighting, speeds up the operation, gives more economic usage of labour and avoids waste of materials by spillage. Being a self-contained unit, it can be easily fixed to all types of cranes, without modification to crane or grab.

The " B. & A." automatic grabline consists of a spring-loaded drum on which is wound a steel wire rope. The free end of this rope or cable is attached to the grab by a short chain or rope sling. Movement of the grab uncoils the cable from the drum against the action of a torsion spring, so that at all times there is a positive tension or restraint sufficient to steady the grab under all operating conditions whatever the angle of the jib.

The grabline can be fitted outside or inside the crane jib, and thimble and " bulldog " type clamps are included to facilitate attachment of the free end of the cable to the sling on grab or bucket.

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CONTRACTORS with dredging equipment within reach of the Persian Gulf and able to dredge approximately 110,000 cubic yards before July 1953 are invited to contact the Kuwait Oil Company Limited, 1, Great Cumberland Place, London, W.1.

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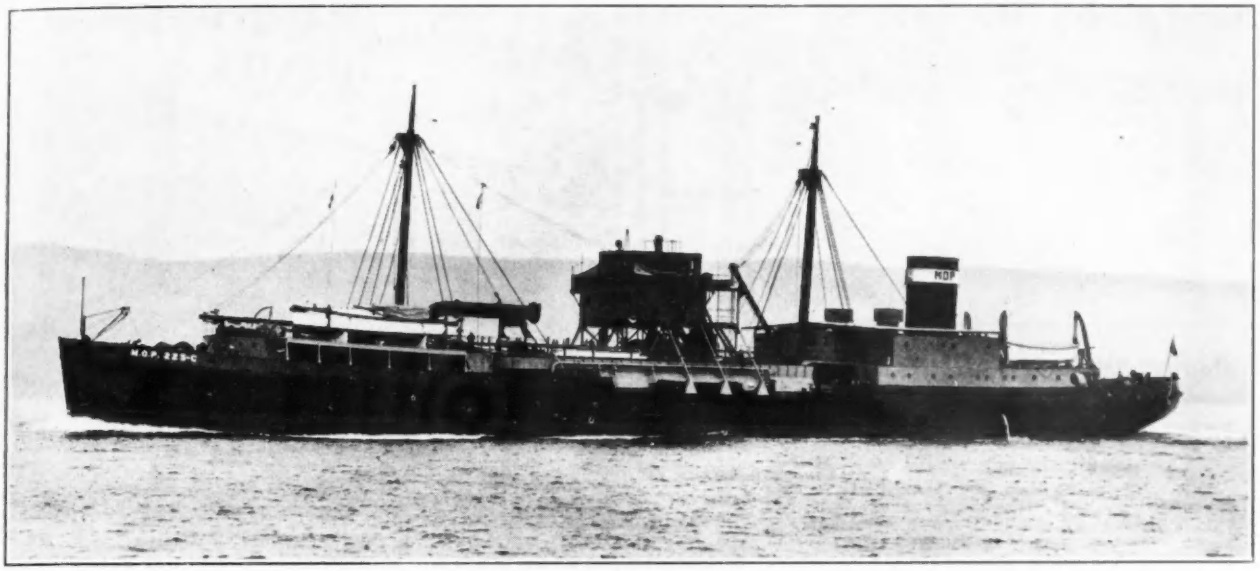

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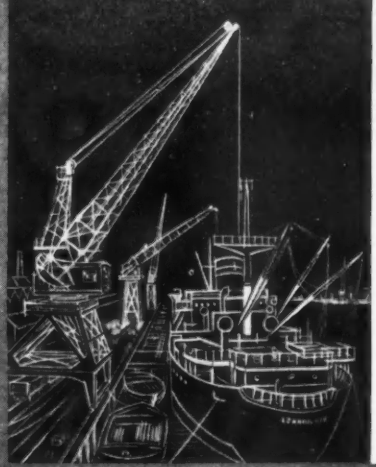

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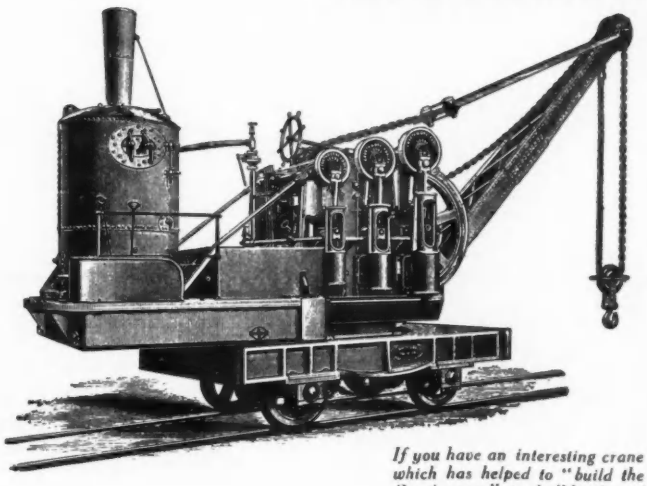

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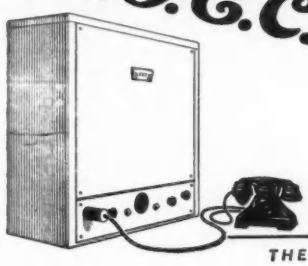

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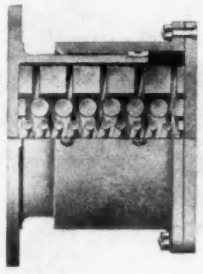

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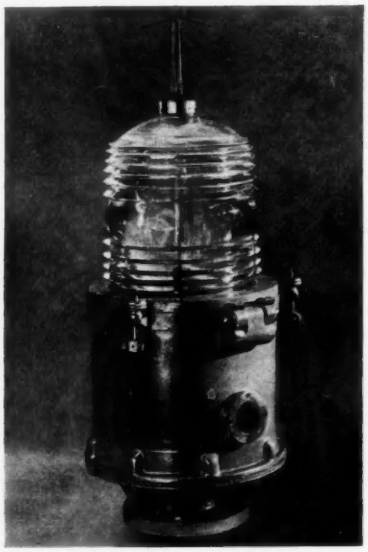

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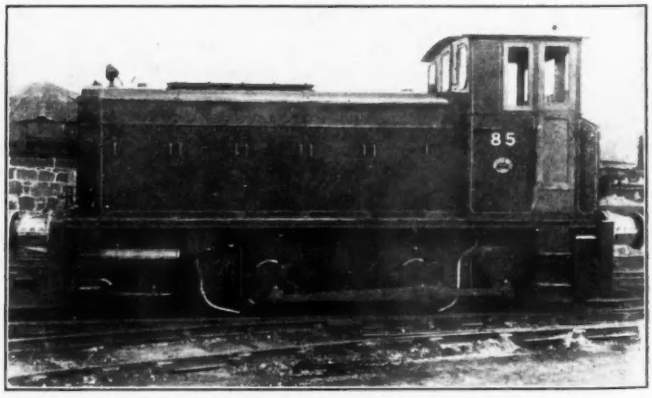

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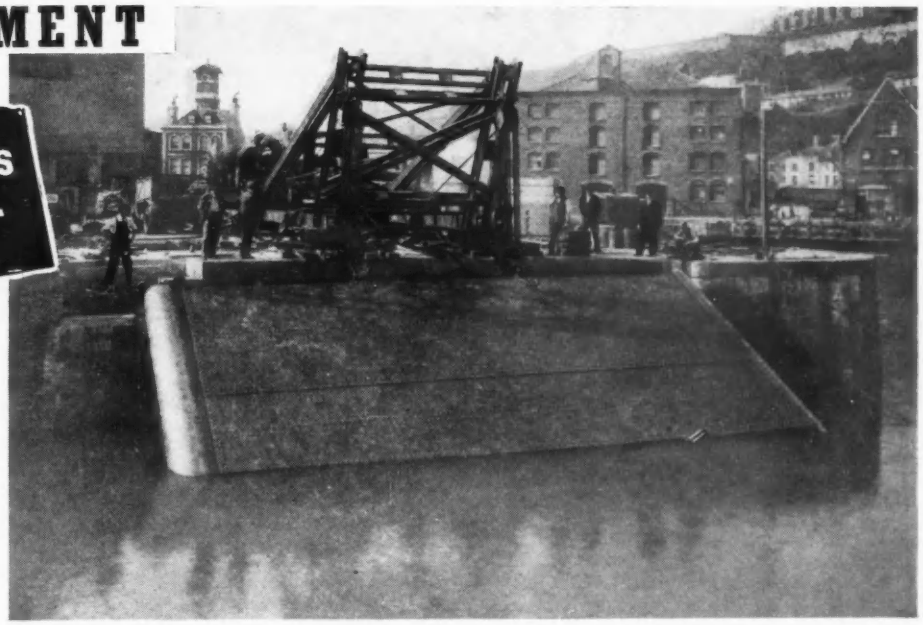

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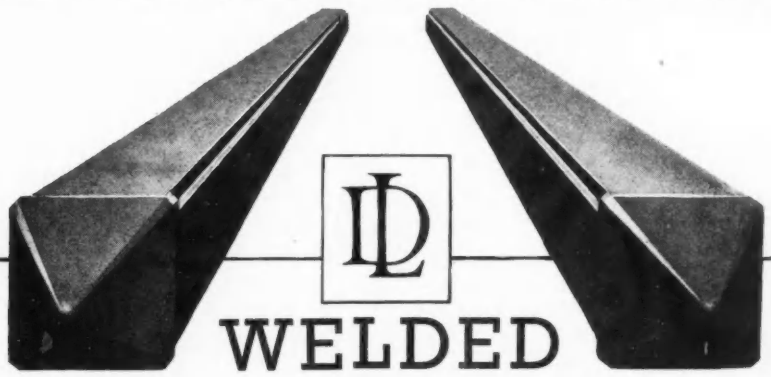

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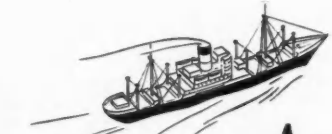

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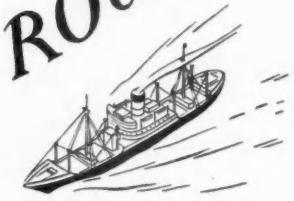

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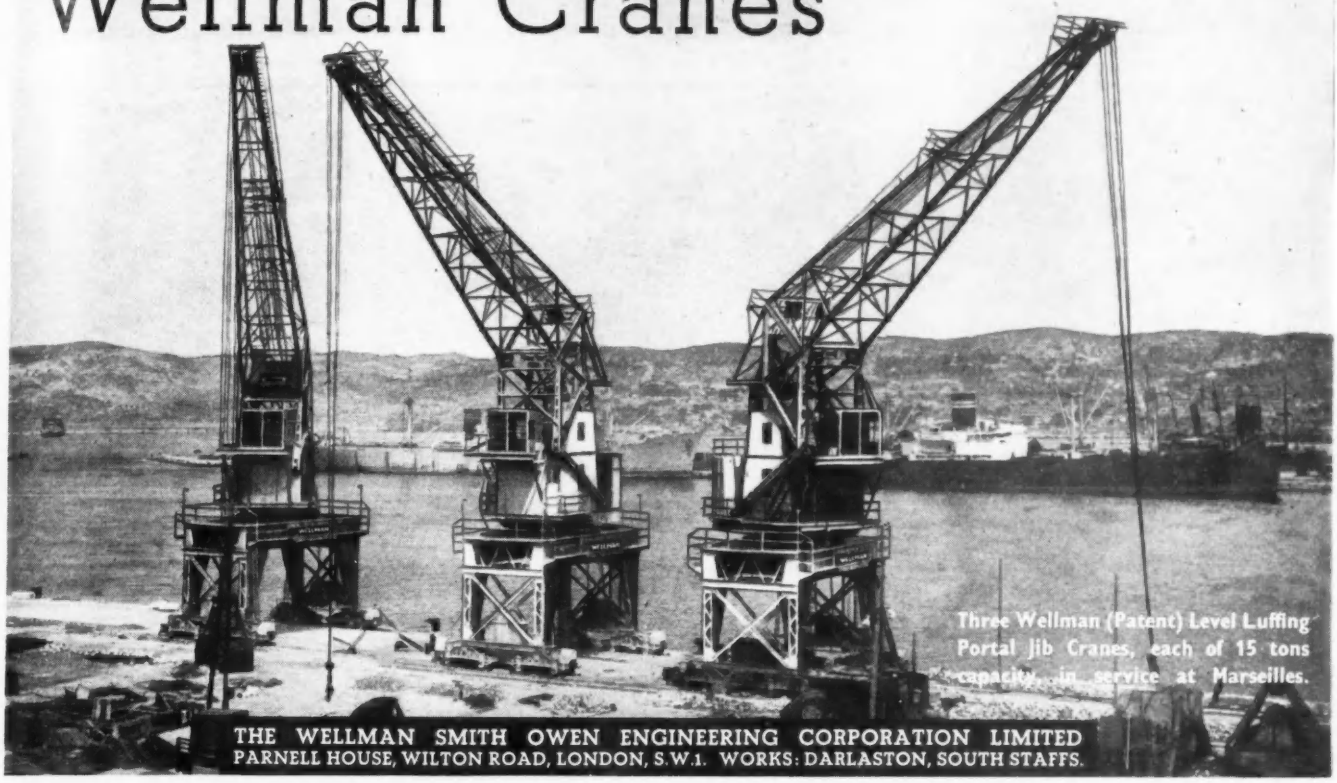

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